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EDITED BY

CARL MURCHISON





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# AN EXAMINATION OF DR. LEEPER'S REVIEW OF HULL'S *PRINCIPLES OF BEHAVIOR*

*Institute for Research in Child Psychology, Hunter College*

LIVINGSTON WELCH

## A. GENERAL CRITICISM

It is seldom that a review itself deserves a review; still, Dr. Leeper's (2) recent critique of Hull's *Principles of Behavior* (1), because of its length and the issues involved, merits special attention. It is unusual for a reviewer to be so painstaking and to make so minute an analysis of any work. In fact it should be difficult for any reader not to be impressed with Dr. Leeper's scholarship, at least on first sight. One is ultimately obliged to say about Dr. Leeper's review, however, what he has said about Hull's book, "It creates a good first impression. But when one spends on it, not the amount of time which most psychologists can afford to give it, but enough time really to test its logic . . . one flaw after another appears" (p. 7). To begin with, throughout Dr. Leeper's review one general evaluation seems to contradict another.

In praise of *Principles of Behavior* he states that in comparison with McGoech's and Tolman's works on learning "neither of these is adapted to American psychology as successfully as is Hull's book" (p. 4), and that . . . in some ways it has the making of a truly great book on learning (p. 17).

Dr. Leeper attacks the book by saying (*a*) "I am aghast at the product of his work. . . . One is driven finally to the conclusion that most of the major conclusions of the book, experimentally speaking, are either meaningless or demonstrably unsound" (p. 8); (*b*) "I am driven to the conclusion that virtually the whole theoretical structure is unsound" (p. 19); and (*c*) "I believe that this discussion has examined virtually everyone of Hull's main principles of learning and habit use . . . what we discover is that there is hardly a principle in the whole collection that can stand up under careful criticism" (p. 49); (*d*) "we could leave the book to establish itself . . . as a piece of charming fiction, with nice pictures, nice printing, and everything. But the trouble is that most of our general psychology texts tend to follow the same tradition which this book sets" (p. 9) (note that *this* attack is directed at American psychologists in general).

Specifically he gives Hull credit for the following four points: (*a*) "for

clearly defining a number of truly worthwhile problems of learning"; (*b*) for presenting "some good experimental material on these problems"; (*c*) for working out "the interrelation between a number of concepts in a way which long has needed to be done"; and (*d*) for stating "many of the concepts sharply enough" and "designating experimental implications of these concepts sharply enough" so as to greatly facilitate "the task of judging empirically the validity of the peripheralistic point of view in learning" (pp. 17-18).

His numerous specific criticisms fall into the following four categories: (*a*) lack of clarity in defining terms, (*b*) insufficient experimental evidence, (*c*) internal contradiction within the system itself, (*d*) a neglect to include and discuss the work of a sufficient number of experimenters who are listed by the critic.

It is hard to understand what Dr. Leeper means when he says that it adapts itself to American psychology more successfully than great works on learning that have gone before and is in any sense a "truly great book on learning," when he believes that the product itself is ghastly, that one flaw appears after another, that most of the major conclusions are demonstrably unsound, and that virtually the whole theoretical structure is unsound. Certainly, Dr. Leeper's specific praise and enthusiastic evaluation of the book are completely inconsistent with such broad and violent attacks. Furthermore, his prediction that Hull's book will adapt itself more successfully to American psychology than the works of Tolman and McGoech, in the light of such formidable criticism, implies that most of us are fools and that these other two authors have failed utterly. But Dr. Leeper has *explicitly* stated that Hull's work and most of our texts are forms of fiction. On the other hand, whatever uncomplimentary implications are involved in his comparison of Tolman and McGoech with Hull are contradicted by the great praise he has bestowed upon the first two authors in this same review.

## B. Specific Criticisms

Is Dr. Leeper justified in making his general attacks? This question can only be answered by an examination of his specific criticisms. Let us examine as many of these as we can. We shall discuss these under the four categories already mentioned.

### 1. *Lack of Clarity in Defining Terms*

*a.* As we have seen, Dr. Leeper made a special point of praising Hull "for clearly defining a number of truly worthwhile problems of learning"

and "for stating many concepts sharply enough. . . ." Elsewhere, however, he states that ". . . in the actual execution of the book, vagueness is often the rule" (p. 8). He actually describes the book's "lack of explicit definitions of crucial terms" as a "third major fault" (p. 25). He goes on to say:

> Nor in the text itself are crucial terms sufficiently defined. For example . . . Hull apparently intends that learning should be understood primarily as something that produces connections of a sort that yield the phenomena of stimulus generalization, response generalization, and stimulus-response generalization. If this is so, the definition of these terms is vital. But, for instance, all that we are given in the definition of response generalization is the statement: "The stimulus involved in the original conditioning becomes connected with a considerable zone of reactions other than but related to the reaction conventionally involved in the original reinforcement. . . ." Now, what does "related to" mean? Must the same muscles be used for a second response to be related to the original response? Is a response "related to" the original one if it produces the same effect on the environment? Or, if "related to" means neither of these things, what is the criterion of relatedness? (p. 25).

The answers to Dr. Leeper's questions are formally stated in Major Corollary III. It states that "each muscular contraction involved in any increment of habit tendency . . . oscillates from instant to instant in the reaction-intensity potentiality which it mediates, thus producing a kind of response generalization in both directions from the response intensity originally reinforced" (p. 319). The primary response generalization of the act as a whole is the mechanical summation of the individual muscular oscillations in response intensity. Hull gives an example of this in Figure 67 (p. 305), where pressures reinforced at 41 grams and below generalized through intensity oscillation as high as 57 grams.

*b.* Dr. Leeper quotes Hull's second Postulate: "All afferent neural impulses active in the nervous system at any given instant, interact with each other in such a way as to change each into something partially different in a manner which varies with every concurrent associated afferent impulse or combination of such impulses."

"This is an assertion . . ." Dr. Leeper says, "that there is a phenomenon of afferent neural interaction. But what are the conditions? What is the difference produced in each afferent neural impulse? How much are afferent impulses modified and what factors produce much or less effect?" (p. 26). One wonders why Dr. Leeper has not asked the same questions and arrived at the same adverse criticisms concerning Pavlov, Tolman, and Köhler, who have used the same concepts, the latter two definitely in what

purports to be scientific theory. As a matter of fact Hull *has* discussed these problems at great length in his "Psychological Memoranda" p. 20, 1940-1944 (this bound mimeographed material is on file in the libraries of the University of Iowa, the University of North Carolina, and Yale University). Moreover, Hull has continued this same discussion in a paper which he read before the Eastern Psychological Association in April, 1945. The title of the paper was *The discrimination of stimulus configurations and the hypothesis of afferent neural interaction.*

Dr. Leeper admits that Hull does state that "other things equal, the magnitude of the interaction effect of one afferent impulse upon a second is an increasing monotonic function of the magnitude of the first." This, according to Dr. Leeper, "says almost nothing." In the very next sentence Dr. Leeper states that "it is easy for us to believe that there are significant afferent interactions: the findings with binocular rivalry, the phi phenomenon, reversals of ambiguous figures, distortions in visual illusions, etc., are abundant testimony that there must be some such effect . . ." (p. 26). Thus Dr. Leeper actually agrees with the first part of the postulate, but he again attacks Hull for attempting to explain other phenomena in terms of this interaction. "Hull," he says, "has probably seized on one of the most minor factors of all in attempting to explain such afferent interactions," but then ((Hull) asserts: "This hypothesis makes possible the explanation of many important behavior phenomena, otherwise inexplicable such as . . ." In commenting, Dr. Leeper says, "One wonders what the word 'explain' means to Hull! Actually, if Hull does attempt to develop this concept in a way that will provide the basis for definite predictions he will find himself treading many paths already traversed by Gestalt psychologists" (p. 26).

In answer to this criticism we may state (*a*) that Hull has plenty of opportunity of developing this concept insofar as the present book is but one of a series of three, and (*b*) today, Behaviorists and Gestalt psychologists are treading a great many of the same paths.

*c.* Hull is again criticized for describing habits on some occasions as "stimulus-response connections" and on other occasions as "receptor-effector connections." Dr. Leeper maintains that "unless a stimulus is the same stimulus only when applied to the same receptor, and unless a response is the same response only when executed by the same effector organ, this designation of habits as receptor effector connections is not the same as their designations as stimulus-response connections." As far as the location of the connection which the habit involves is concerned, receptor-effector connection is more precise than the term stimulus-response, but Dr. Leeper

certainly has not shown how such an interchange of terms can cause any real danger of confusing or misleading the reader.

The general impression one obtains from reading Dr. Leeper's criticism of Hull's language is largely a demonstration of great perseverance and vigilance in an effort to catch Hull offguard in his expression of thought, if only for one moment. Under such conditions any author may be condemned before he starts, because one may always count on language being misleading to some extent to any prejudiced reader or listener.

### 2. *Insufficient Experimental Evidence*

"The most serious problems," says Dr. Leeper, "are the book's dependence on a small number of studies (often experiments with small numbers of subjects) . . ." (p. 23).

*a.* In discussing Hull's principles of habit-formation, Dr. Leeper attacks eight of them on the grounds that there is little or no experimental evidence to support them, and ample empirical support to refute them. The first principle is Hull's Postulate 4, which Dr. Leeper does not quote, but interprets as meaning "all adequate stimuli favored by proper temporal relations become connected with the response, if associated also with the proper reinforcement. What is learned is not something determined by highly variable perceptual organizations within the learner, but is primarily stimulus determined" (p. 31). Let us assume that the first part of his interpretation of Hull's postulate is accurate so that we may immediately direct our inquiry as to what Dr. Leeper himself means by "variable perceptual organizations" and where and how we may find them in the learner? In criticizing Hull's principle, he says, "It is not surprising that Hull cites no experimental evidence to support this principle. It would be an endless task to prove that all stimuli in a conditioning situation become connected with the response" (p. 31). Not only would the task be endless, but quite irrelevant to Hull's proposition, for Hull does imply that this connection involves all *adequate* stimuli and obviously, this does not include all of the stimuli in the conditioning situation. To disprove this principle Dr. Leeper refers to an experiment reported by Lashley in which rats under certain circumstances failed to learn a connection between a triangular form and a positive jumping response. Dr. Leeper maintains that according to Hull's theory they should have "because (*a*) the triangle certainly stimulated the rat's eyes, (*b*) rats can learn to distinguish triangles from circles, and (*c*) the triangle as a stimulus was presented only with proper time relations to the response and reinforcement" (p. 31).

We must understand that the Lashley experiment is an extremely complex form of discrimination learning in which large amounts of what Hull would call generalized excitatory potentials and inhibitory potentials are operating on at least three generalization continua. Moreover, these miscellaneous reactive and inhibitory potentials are all interacting in various complex ways. The fact that the animals chose the large circle rather than the triangle does not prove that the triangle as a stimulus did not command any reaction potential, but only that in the complex competition or mixup its reaction potential was less than that of the circle. Thus Dr. Leeper's supposed crucial case turns out on the face of it to be a fallacy of the type known as the *non sequitur*. Moreover, Hull has pointed out at some length (pp. 207-209) that the habit strength acquired by the various components of compound stimuli "differ widely" (p. 207). In fact Hull ends with the following statement which Dr. Leeper's cautious eye was careful to ignore. "Unfortunately," says Hull, "as yet very little experimental effort has been directed to the solution of these problems. For this reason most of the suggestions listed above must be regarded as hardly more than conjectures suitable as points of departure for future investigations" (p. 209).

*b.* Though Hull would maintain that learning was stimulus-determined in part, he makes it quite plain that the stimulus involved is not a single entity, but pattern of stimuli. Furthermore, he explains in his final chapter (p. 397) that some stimuli in a given situation may be more effective than others. He has not as yet discussed all of the laws governing the emergence of a stimulus pattern effective in a given situation, in a manner similar to the Gestalt psychologists, still, their laws do not contradict any phase of Hull's theory. This subject he can discuss at will in his next two volumes.

Leeper suggests that in connection with the rat experiment "the evidence points . . . not to the mechanical sort of interpretation offered by Hull, but to an interpretation which Lashley has expressed in this way: "The mechanism of nervous integration is such that when any complex of stimuli arouses nervous activity, that activity is immediately organized and certain elements or components become dominant for reaction while others become ineffective. This constitutes a 'set' to react to certain elements . . ." (p. 32, Leeper).

In defense of Hull we may say that if he admits that a certain stimulus which affects an organism is a pattern, or, if you will, a configuration or an organization of stimuli, then it follows by implication that the effect which this pattern has on the nervous system must likewise be configural in nature in order to correspond to the stimulus. If Hull does not make an issue of this point the implication is still there to be made explicit at a later date

when his work will really be finished. This much, however, he does state, "It is a fact that in a very large number of situations the question of whether or not a given response will be followed by reinforcement depends upon the presence or absence of a particular *combination* of physical circumstances and so, for the organism, upon a particular *combination or pattern* of stimulus elements rather than upon the presence or absence of any of the components. Since each combination of stimulus elements will modify to some extent the afferent impulses produced by each stimulus component, any change in the stimulus compound will also modify to some extent the afferent responses initiated by all the remaining stimulus components" (p. 397).

*c.* Dr. Leeper attacks another principle of habit-formation. He *interprets* the principle as meaning that "the ordinal position of each trial determines in a relatively simple way, the increment of habit strength from that trial, and more specifically, habit development is a positive growth function of the number of trials." "This" says Leeper "is a sweeping conclusion, a conclusion of the sort that requires extensive evidence before it may be accepted. But Hull only presents three studies that support this conclusion. An entomologist would not be content to present three species as evidence of the proposition that all arthropods have six legs; but Hull expects us to respect his book as scientific when he presents three specimens for a generalization covering such a large and heterogeneous field as the field of learning" (p. 32).

First of all, Dr. Leeper does not seem to understand that a postulate used in a theoretical system *can be an hypothesis itself* or a rule which has only enough present plausibility to justify the labor of the trial. Therefore, little more empirical evidence is offered at the presentation of these postulates than is necessary to illustrate their meaning in the concrete. Secondly, with the limited experimental material on hand, any system builder, for the time being, will have to be contented with a small number of experiments to support many of his postulates. His postulates and, in fact, his system as a whole, however, should be granted consideration under these conditions until empirical data contradicts this system in part or in whole. Thirdly, Dr. Leeper has not quoted Hull's statement, but *again* has taken the liberty of interpreting him incorrectly. What Hull actually says is "The greater the number of trials (and presumably, the greater the relative habit strength of the reinforced reaction), the greater will be the per cent of correct reactions" (p. 108). "The greater the number of reinforcements (and, presumably, the stronger the habit), the greater will be the amplitude of the evoked reaction. Accordingly, the amplitude is said to be an increasing function of the number

of reinforcements" (p. 104). In a footnote Hull states, "This statement holds for certain reactions, such as a salivary secretion and the galvanic skin reaction, but *apparently not for all*" (p. 104). In the beginning of the chapter Hull is even more cautious. It is important to note he says "that habit strength cannot be determined by direct observation, since it exists as an organization as yet largely unknown, hidden within the complex structure of the nervous system. This means that the strength of a receptor-effector connection can be determined, i.e., can be observed and measured only indirectly. . . . As our analysis progresses we shall find that habit strength depends upon various antecedent factors in addition to the number of reinforcements" (p. 102). A comparison of Leeper's description of Hull's assertion and Hull's own language might lead some reader to suspect that Dr. Leeper was deliberately trying to misinterpret Hull.

*d.* Dr. Leeper attacks Hull's assertions that "habit strength declines markedly as the delay in the onset of the unconditioned stimulus increases beyond the optimum, the diminution being a simple decay function of the amount of delay beyond the optimal relationship." . . . And that "the most favorable temporal arrangement for the delivery of the conditioned and the unconditioned stimuli is to have the latter follow the former by something less than half a second" (p. 176, Hull). (This time we have taken the liberty of quoting Hull rather than his critic who again describes Hull in his own words.) Dr. Leeper maintains that Hull presents only one experiment to support these conclusions and the critic presents another experiment whose conclusions contradict the first. Hull is thus defeated this time in terms of seconds. In the second experiment by Bernstein it is shown that "with forward conditioning he found roughly equal frequencies of conditioned reaction for each interval from a .25 sec. up to the longest interval employed" (1.48 sec.). This merely indicates that habit strength declines at a somewhat slower rate, but it does not disprove the principle.

*e.* Dr. Leeper criticizes Hull for asserting that punishment produces learning only through the need reduction which occurs when punishment ends (p. 38). "In many learning situations," says Dr. Leeper, "the pain does not end until long after the response which produced the pain. When a person scalds his face, for example, the pain does not end soon. . . . Such a great temporal separation of need reduction from the response ought, according to Hull's scheme, to prevent learning" (p. 39). The relationship between punishment and learning, in the ultimate analysis, is probably one of the most complex problems is psychology. Dr. Leeper's criticism only adds confusion to the situation. If a child touches a hot

stove and is burned, it is true that the pain will persist long after he has removed his finger from the stove. Noone will disagree with Dr. Leeper on this issue. Actually, children learn to remove their fingers from a hot stove to prevent an *increase* of the injury. The child who removes his finger from a hot stove has learned this fact. In elaborating his principle Hull has only to state that punishment produces learning through need reduction or by the prevention of an increase of a tissue need or injury. In the first instance this may occur when the punishment ends (e.g., the child touches an electrically charged wire and is shocked. The moment he removes his hand the punishment will end). In the second instance this may occur when the punishment no longer increases in strength (e.g., if the child touches the stove for one-half a second, the burn may be very slight, but if he leaves his finger on the stove for a minute or two he may burn it to a crisp).

*f.* Dr. Leeper next attacks Hull's Corollary XIV which is: "When conditioned reactions are set up by means of massed reinforcements, conditioned inhibition is generated which, at the outset of extinction, is disinhibited through the change in the functioning afferent impulses, with the result that the curve of experimental extinction shows an initial rise" (p. 293).

Dr. Leeper points out that in the support of this Corollary Hull has only presented one experiment. The critic admits that Hull "speaks of it, too, as failing to conform in some ways with theoretical expectations" (p. 42). The way Dr. Leeper has stated Hull's criticism of the corollary, one might infer that the author was trying to hold on to it regardless, in hopes that its weakness would go unnoticed. Hull's own language is very strong. Having pointed out a discrepancy in the corollary he states that "the discrepancy is of considerable importance, since it points to a *serious defect* in the postulates which generate Corollary XIV. This matter clearly needs further intensive experimental investigation . . ." (p. 293). There is not very much purpose in criticizing a defect in a system when the author has done so himself and clearly indicates that this portion of his work requires alteration and improvement.

*g.* Dr. Leeper criticizes Hull for asserting that "the important aspect of a reward is the 'need reduction' which it brings rather than any positive quality of the reward experience" (p. 39, Leeper). He feels that Hull must answer the question "Why should a need reduction produce learning?" Dr. Leeper believes that the positive value of the reward is crucial. "For example," he says, "when you offer a piece of candy to a small child and let him take a tiny taste of it, you are reducing the need for candy in the

sense that, if he took perhaps a thousand times as much candy as he got in his hasty lick, he would be content to stop eating candy. But in every other respect you have *aroused* a need rather than reduced it. The child may have been busy with his toys the moment before, with no active motive of craving candy, but now the craving for candy has been excited as an active process and his behavior becomes dominated by the knowledge that you have some candy and that you are withholding it from him. The positive effects of a reward are important in conduct in such a case, not any need reduction. The old Roman banquets may violate our aesthetic sense, but they were based on a correct formulation that behavior is directed, not as a need reduction, but as a satisfaction in a positive sense . . ." (p. 40).

Dr. Leeper seems to be ignoring the fact that different degrees of a tissue need may call forth different responses. If a child is actually suffering from the pangs of hunger, it is unlikely that he will play contentedly with his toys. This great tissue need will compel him to hunt for or cry for food. If on the other hand, the child has had a big supper he may play contentedly with his toys until he is offered a piece of candy. The fact that he now manifests a craving for the candy simply indicates that the reduction of the tissue need was not complete. If it had been completely reduced the child would have gagged rather than have eaten the candy. This brings us to the example of the Roman banquet. Here we find an actual instance of reaching or approaching the "gaging point." Any reward such as food may have both an *immediate* and a *mediate* value which is dependent upon need reduction. The mediate value we shall discuss in connection with Dr. Leeper's criticism of Hull's law of reinforcement. For the moment let us consider the *immediate* attraction value of food. Eating reduces the effects of hunger caused by a tissue need. The reduction involves pleasure and explains why the organism is attracted to the food. Once, however, this need has been satisfied *fully* no more immediate pleasure can be obtained from *eating* food, until the individual vomits. It was the custom at Roman banquets to seek the *immediate* pleasure of *eating* when completely satiated with food.

If we turn to *Principles of Behavior* and read what Hull actually says on the subject of tissue need, we doubt whether the reader will find his statements difficult to accept. "It is a matter of common observation that, *as a rule,* when an organism is in need of food, only those acts appropriate to the securing of food will be evoked, whereas when it is in need of water, only those acts appropriate to the securing of water will be evoked. . . ." The initiation of learned or habitual patterns of movements or behavior is

called motivation. . . . The evocation of action in relation to primary needs will be called primary motivation" (p. 226).

Note that Hull has been cautious enough to use the phrase "as a rule." It is customary to present the rule first and the exceptions afterwards. The expectations are that this complex problem will be discussed in one of the two remaining volumes he is writing. What is needed is a description of the behavior we may expect, (*a*) when the organism is in great need of food, (*b*) when it is no longer suffering from hunger, though the need reduction is not complete (e.g., the well fed child who will eat a piece of candy given to him), and (*c*) when the organism is completely satiated. At such a time Hull can also deal with the problem of the immediate and mediate attraction value of a reward to which no psychologist has given sufficient attention.

*h.* Dr. Leeper objects to Hull's law of reinforcement and Thorndike's law of effect as being inadequate. In support of his objection he refers to a pair of experiments conducted by Hull and himself. He states that "when the rats saw the goal-material not desired at the time, even though that situation was frustrating to them, they learned something that helped them to make an opposite selection of paths on the following day when their motivation was shifted . . ." (p. 37). Dr. Leeper is making the naïve assumption that because a well fed animal at the moment does not eat food this food cannot be considered a reward or a phenomenon which would attract this organism. Such an assumption is very easy to disbelieve. There is no reason to deny that there is at least an indirect association between the food in this situation and need reduction, which would allow one to consider the food a *mediate* reward. In the human organism this is a fact. The well fed man will purchase food for tomorrow or next week. Similarly, the well fed squirrel will bury his food, and the well fed dog will bury his bone.

Dr. Leeper attempts to rule out the exploratory drive in his maze experiment. "The mazes," he says, "were so simple, and so many trials were given that it hardly seems appropriate to say that any satisfying exploratory drive could have been of much relative importance after the earliest days of training" (p. 37). We would agree that as far as "sight-seeing" is concerned, the rats had little to look forward to, but certainly the urge to move about must have been present. The rats had no other alternative than to stare at Dr. Leeper. The well rested, healthy rat, however, is an organism which has an urge to move, to say nothing of an urge to escape from a small confining maze.

### 3. *Internal Contradiction within the System Itself*

Hull has stated that "secondary reinforcement may be acquired by a stimulus from association with some previously established secondary reinforcement, as well as with a primary reinforcement. It would appear that transfer of this power of reinforcement from one stimulus situation to another may go on indefinitely, given the conditions of stable and consistent association" (p. 97).

In commenting, Dr. Leeper says: "If such is the case, the secondary reinforcement must be associated with retracing and with entrances into blind alleys just as truly as with movements down each segment of the true path—why, then, does the secondary reinforcement help the rat to learn to take the correct path?" (p. 38).

The difficulty is at least partly explained by Hull's Goal Gradient hypothesis. The errors which the animal makes nearest the goal he learns to eliminate sooner than those farther away from the goal. The sequences of stimuli and responses which constitute the shorter path to the goal will be more strongly reinforced than the sequences of the stimuli and responses of the longer path. Hence, the animal will show preference to the shorter path, which is the true path. Even if the Goal Gradient were not adequate to explain this phenomenon, the worst criticism that Dr. Leeper could make would be to state that Hull has failed to explain an aspect of animal behavior which no one else has explained.

### 4. *Neglect to Discuss the Work of a Sufficient Number of Experimenters*

"Even an inspection of the index of the author's names," says Dr. Leeper, "is sufficient to reveal the one-sidedness of the evidence which Hull employed" (p. 24). The critic then proceeds to present a list of all of the names which he thinks should have appeared in this index. Since *Principles of Behavior* is not a textbook the author is at liberty to exclude any material which he does not find necessary to the exposition of his psychological system. Dr. Leeper, however, also accuses Hull of refusing to "discuss or even mention, a considerable number of expertly conducted experiments which run contrary to his main conclusions" (p. 23 ). If this is true, Dr. Leeper has not proved it.

## C. Conclusions

In conclusion we may say that the nine major attacks which Dr. Leeper has directed at Hull's *Principles of Behavior* have by no means proved, as he insists, that the author's theoretical system is unsound. Dr. Leeper's arguments, at times, have been presented in vague language; they have

made use of incorrect interpretations of the text and invalid inferences. No one will deny that these "principles of behavior" would profit by more experimental evidence, but this is simply an indirect way of saying that Hull's theory is a theory. Dr. Leeper criticizes it as if it were supposed to be a complete and final set of mathematical laws. Hull begins Chapter One by stating "This book is the beginning of an attempt to sketch a systematic objective theory of the behavior of higher organisms." In the last chapter he states "Empirical observation, supplemented by shrewd conjecture, is the main source of the primary principles or postulates of a science. Such formulations when taken in various combinations together with relevant antecedent conditions, yield inferences or theorems, of which some may agree and some may not. Primary propositions yielding logical deductions which consistently agree with the observed empirical outcome are retained, whereas those which disagree are rejected or modified . . ." (p. 382). We may raise the question—Is this approach to psychology to be condemned? If so, then one can sympathize with what Dr. Leeper has tried to do. If, on the other hand, it is a good approach, psychology as a whole would profit by giving a system builder such as Hull the aid of serious and constructive criticism. Long range systematic projects in psychology are sufficiently rare and sufficiently important to merit coöperative interest, especially at frankly unfinished stages of the work.

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*Institute for Research in Child Psychology*
*Hunter College*
*695 Park Avenue*
*New York City*

*The Journal of Genetic Psychology*, 1945, **67**, 17-26.

# ADDITIONAL NORMS FOR EMERGENCY BATTERY*

*Danvers State Hospital, Hathorne, Massachusetts*

GRACE H. KENT[2]

This is the final installment of a study begun in 1941, two earlier papers having appeared in *The Journal of Psychology* in 1942 and 1943 (1, 2). Norms have been published for each of six written tests with a one-minute time limit, and the plan for standardizing them without time limit has already been announced.

Tentative norms are now offered for the multiple choice tests called *Information, Similarity, Essential Property,* and *Essential Difference,* with no time limit; for *Directions B* with two-minute timing; and for six independent scales of *Graduated Opposites,* presented without time limit. Owing to war-time conditions it has not been possible to standardize these tests on any such scale as would be desirable. The norms are offered in an extremely crude state, on the ground that there is no prospect of an opportunity to make them more adequate.

## A. STANDARDIZATION AND SOURCES OF MATERIAL

The method of group-standardization was essentially similar to the procedure described at greater length in 1934 (3) with reference to an earlier edition of the battery. The children were first required to do a little work on each page under a time limit; after which they were given red pencils and were permitted to take their own time for finishing the work on each page. It was thus possible to obtain two independent scores from each child for each test: a timed score, based upon the work done in lead pencil; and a second score, including all the correct responses on the page. (The *Opposites* test, which was wholly untimed, furnished occupation for the children who completed the battery ahead of the others.)

The number of children included in the standardization of the battery is 811. The Massachusetts towns represented are Danvers, Belmont, and Andover. A few additional untimed records were obtained in 1942, from

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[1]With grateful acknowledgments to Eleanor H. Hayes, who obtained over 300 records from school children of Belmont, Massachusetts; to Celia H. Sheldon, who contributed 100 records from schools of Huntsville, Texas; and to the following persons who have assisted in scoring and tabulating the records: Jean Davis, Marion Garno, Barbara Greenberg, Mary E. Harvey, Joyce Hayes, and Helen Tandy.

schools of Jersey City and from Huntsville, Texas. Two groups of third-grade children were included, in order to determine the lower limit of the discriminative capacity of the tests. All the other children were in Grades 4 to 7, with a strong preponderance of sixth-grade groups. Inasmuch as it was not convenient to restrict the standardization to "middle section" children, it has seemed advisable to discard all records obtained from children more than one year older or more than one year younger than the majority of the class. Most of the records thus sacrificed were from older children who were several years retarded; but the records from a few children who were more than one year advanced have been just as carefully rejected for classification by age.

Even with this elimination of the extremes, the material is not well balanced. Numerically the 11-year-old level is best covered, with 288 cases; but nearly all these children were from sixth grade in the schools of Belmont, a suburban town known to be well above the Massachusetts average. A large proportion of the 10-year children were from Andover, another town from which high achievement might be expected. The 12-year and 13-year levels are weak numerically, and the 13-year level suffers additionally by reason of being at the end of the age-range included.

The *Opposites* tests were introduced recently, after the standardization of the battery was well advanced. Mimeographed forms were prepared, containing the lists *A* and *B* in parallel columns and with ample space for written responses. In the Danvers schools these forms were presented to two groups of high school students who did not take the battery tests, and were given also with the battery to seven groups of younger children who were instructed to leave this page until the last. A few very slow workers did not finish the *Opposites* page, and the total number of records obtained from school children is only 253.

## B. Auxiliary Data

An essential feature of the standardization is the use which has been made of any available records which could be classified by "mental age," by way of supplementing the very scanty material classified by the ages of the children.

The earlier forms of the four multiple choice tests, containing about 26 items to the page, were standardized without time limit during the period 1928-33 (3). When these tests were revised in 1941, the revision involved the elimination of eight or nine items but did not involve the introduction of any new and untried items. By means of a cardboard stencil which covers the deleted items and exposes only the items retained in the revision, it is

possible to take the score of the revised test from the old-form record.

The 1800 records used in the standardization of the earlier form had unfortunately not been preserved, but there were a few hundred clinical records which had escaped destruction. Each subject whose test records were used in this study had been given a "mental age" rating, based upon the median of at least five independent tests exclusive of the test being calibrated for standardization. The median ratings were used for classification of cases, exactly as if they had represented actual ages. The median scores of the revised tests, at the several mental levels, were used in the construction of "mental age" curves. The two sets of data have been kept entirely separate at all times. The "mental age" curve for each test, superimposed upon the natural age-curve, has been used chiefly as an aid in the delicate and dangerous procedure of curve-smoothing; and has served additionally for extending the natural curve at the ends.

Even when based upon a much smaller number of cases, the "mental age" curve is usually smoother than the natural one. Without the supplementary data it would be quite impossible to offer norms based wholly upon the age curves. Because of the importance of the auxiliary material, it has been drawn from all possible sources. Even the normal children from whose records the natural curves were derived have been re-classified according to their mental levels as indicated by the tests, and in many instances their scores have been required to do double duty.

In the classification according to mental level, clinical data obtained from subjects of widely divergent ages have been combined with data obtained by the same method from school children. There has been, however, no combination of timed and untimed tests for purposes of calibration. Median ratings by five timed tests have been used for calibrating a timed test; and the median ratings by five or seven untimed tests have been used for calibrating the untimed tests.

### C. Numerical Results and Norms

The results are shown graphically in Figures 1 and 2. In each unit the actual age-curve is represented by the solid line and the "mental age" curve by dots. Each graph shows the median score at any given age or mental level. (The range of individual scores is very wide, but not more so than is found in almost any collection of data for test standardization.)

There are three series of *Opposites* tests: *A*, *B*, and *A* plus *B*; and each series has an upper and lower scale. The same base line is used for the two scales of a given series, the upper curve representing the lower scale.

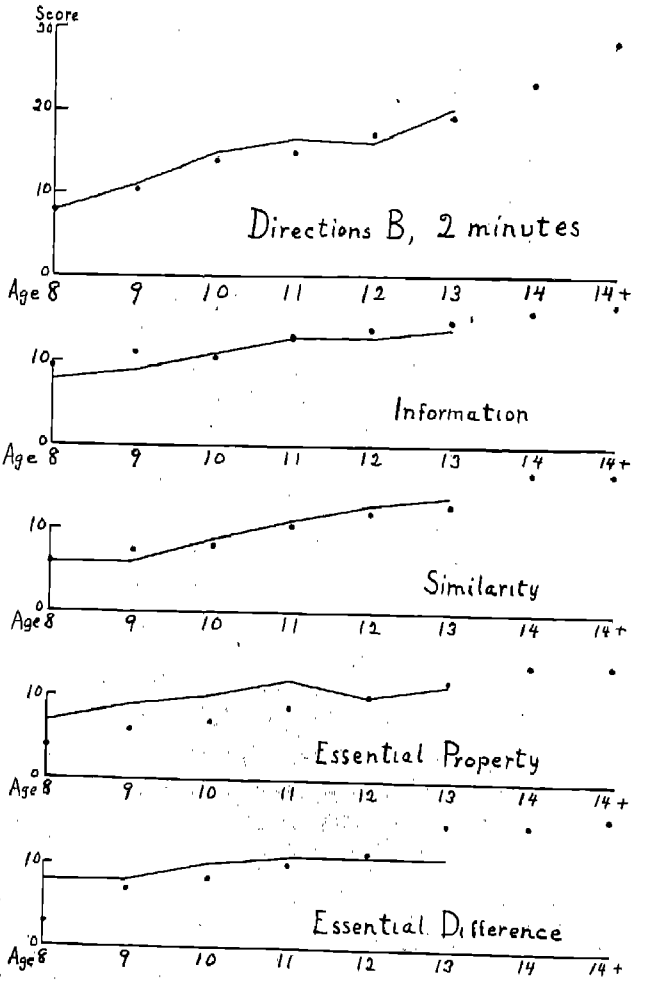


FIGURE 1

SOLID LINE SHOWS MEDIAN SCORES OF CHILDREN CLASSIFIED BY AGE NEAREST BIRTHDAY; DOTS SHOW "MENTAL AGE" CURVE

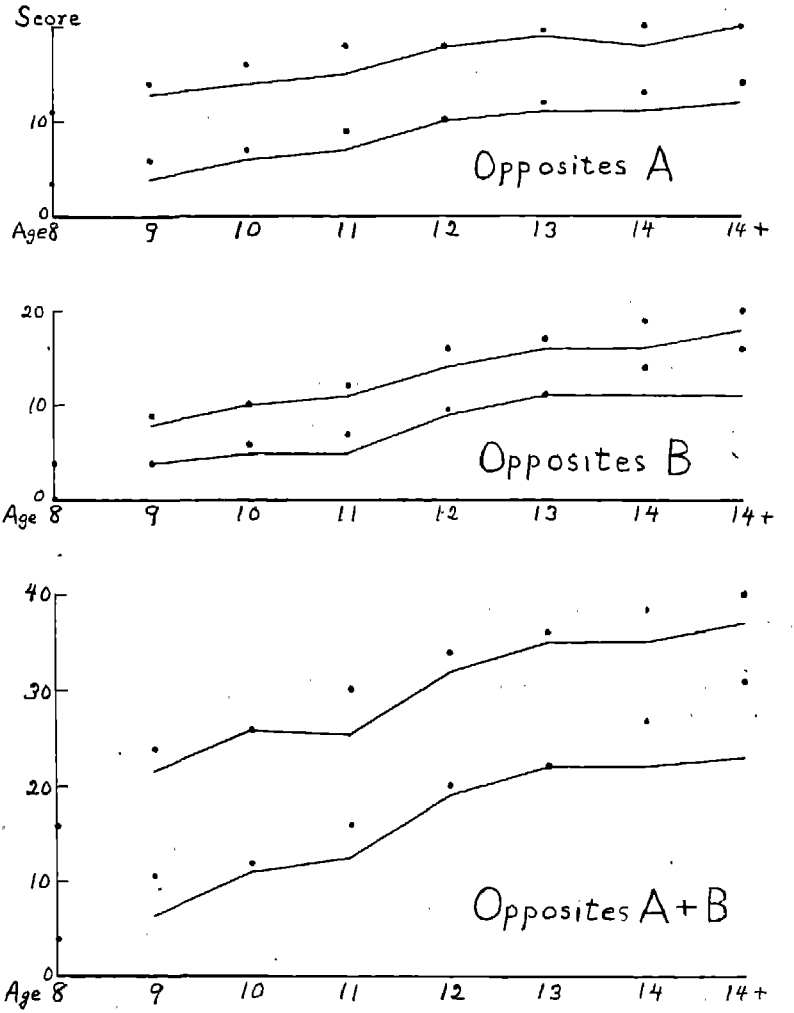


FIGURE 2

SOLID LINE SHOWS MEDIAN SCORES OF CHILDREN CLASSIFIED BY AGE NEAREST BIRTHDAY; DOTS SHOW "MENTAL AGE" CURVE

(Inasmuch as the scores are unweighted, a given score has a higher value for the upper scale than for the lower scale.)

TABLE 1

1943 NORMS FOR EMERGENCY BATTERY*

| Directions *B* Two minutes | Age | Information | Similarity Without time limit | Essential property | Essential difference |
|---|---|---|---|---|---|
| 7- 8 | 8 | 6- 8 | 4- 5 | 5- 6 | 6- 7 |
| 9-11 | 9 | 9 | 6- 7 | 7- 8 | 8 |
| 12-13 | 10 | 10-11 | 8- 9 | 9-10 | 9-10 |
| 14-15 | 11 | 12 | 10-11 | 11-12 | 11 |
| 16-18 | 12 | 13-14 | 12-13 | 13 | 12-13 |
| 19-20 | 13 | 15 | 14-15 | 14-15 | 14-15 |
| 21-24 | 14 | 16 | 16-17 | 16 | 16 |

*Any score higher than the 14-year score is rated as 14 plus.

TABLE 2

1943 NORMS FOR SIX *Opposites* SCALES

| Age | *A* Lower scale | *A* Upper scale | *B* Lower scale | *B* Upper scale | *A* + *B* Lower scale | *A* + *B* Upper scale |
|---|---|---|---|---|---|---|
| 8 | 10-11 | —— | 5- 6 | —— | 16-19 | —— |
| 9 | 12-13 | —— | 7- 8 | —— | 20-23 | 8- 9 |
| 10 | 14-15 | 6- 7 | 9-10 | 5- 6 | 24-26 | 10-12 |
| 11 | 16-17 | 8- 9 | 11-13 | 7- 8 | 27-29 | 13-16 |
| 12 | 18 | 10 | 14-15 | 9-10 | 30-34 | 17-20 |
| 13 | 19-20 | 11-12 | 16-17 | 11-12 | 35-39 | 21-24 |
| 14 | —— | 13 | 18-20 | 13-14 | 40 | 25-28 |
| 14 plus | —— | 14 up | —— | 15 up | —— | 29 up |

The number of cases differs for different tests: for *Directions B* with two-minute timing, 637 children classified by age and 679 subjects classified by mental level; for the four multiple choice tests, 811 children classified by age and 317 subjects classified by mental level; and for the six *Opposites* scales, 253 children classified by age and 275 subjects classified by mental level.

### D. PRACTICAL SIGNIFICANCE AND LIMITATIONS

A casual study of the graphs reveals that these tests are by no means equally trustworthy from a statistical point of view and that the larger number of cases does not necessarily yield the smoother curve. When considered with reference to practical serviceability in the clinic, the different tests show still wider differences.

A time limit is a great aid in making a test discriminative for a wide range of mental levels. It is comparatively easy to devise a test in which

a rapid worker can surpass a slow worker in respect to the ground covered within a specified time interval; and correspondingly difficult to invent a test which can be given without time limit and yet show a clear year-to-year gradation with the increasing age of the children.

The two *Directions* tests, every item of which had seen at least eight years' clinical use before the tests were offered for publication, have been found useless as untimed tasks.

These tests were intended to be sufficiently easy of comprehension to be correctly performed by an eight-year-old child having adequate facility in reading; and they were filled with catchy items which would be conducive to careless errors, on the assumption that the older children might be expected to work more carefully (as well as more rapidly) than the younger ones. The results, however, show that the perfect score is very rare at any age or any mental level; and that the near-perfect score is found as frequently at 10 years as at 13 years. The untimed records show remarkable constancy of achievement: each of the tests yielded identical median scores for the ages 10, 11, 12, and 13; namely, score 24 for *Directions A* and score 27 for *Directions B*. It may be possible to make some use of them as untimed tests for the mental levels 8 to 10 years, but it seems hardly worth while to offer norms for so limited a range; nor is a straight line of such interest as to call for graphic presentation.

The serviceability of these two units as timed tests is not diminished by this evidence that they require a time limit to make them discriminative. The earlier standardization (2) showed *Directions A* to be suitable for one-minute timing, but indicated that *Directions B* would be more useful as a two-minute test. Accordingly, this test has been given with two-minute timing in all recent group examinations. The other five tests were given with a one-minute time limit and were evaluated by the published norms (2). It was the median rating by these five tests which was used for calibrating *Directions B* as a two-minute test. The perfect score for this test is 32, whereas the median score at the 14-plus mental level is only 28; thus indicating that the test is abundantly discriminative for clinical use when used with two-minute timing. Now that there are norms for the two-minute test, it is recommended that the one-minute timing be wholly discontinued. The two-minute test is probably more than twice as strong as the one-minute test, because the more difficult items are on the lower half of the page.

*Information* was found to be weak as a one-minute test, inasmuch as the upper-level subjects usually finished the page within the time limit. The

proportion of perfect scores is not appreciably increased by omitting the time limit, and in many cases there is a saving of a few seconds' time. As an untimed test it gives the slow worker a better opportunity to show what he can do.

*Similarity, Essential Property,* and *Essential Difference* may be used either as timed or untimed tests, or as both. When any one of these tests is used in individual examination as an untimed test, it is a very simple matter to obtain an additional score by handing a red pencil to the subject at the end of the first minute. Comparison of a subject's timed and untimed ratings is frequently more significant than the statistical evaluation of either score.

Nothing further is offered for the test *Arithmetical Reasoning.* In the earlier work of this series it was included with two-minute timing, and was given to about 400 children. These records were tabulated with a view to the possible revision of the published norms, but the results indicated that such revision is not urgent. In the latter part of the series this test was dropped, in order to make a place in the schedule for *Opposites.* The use of arithmetical tasks in a clinical examination is at best somewhat questionable. They are greatly disliked by many clinical subjects, and therefore do not command a high level of coöperation as compared with other tests.

*Graduated Opposites* is now offered for the first time as a standardized test, although a slightly different form has carried tentative norms for upwards of 15 years.

The scoring of this test is not quite so objective as that of a written test; but the writer cannot name any other orally-presented test which even approaches it in respect to the degree of objectivity. The scoring key (1, p. 158) probably includes very nearly all the responses which are entitled to full credit. Occasionally there is difference of opinion concerning the recognition for half credit of some inferior response, and it would not be possible to make up a list of half-credit responses which would be acceptable to all examiners. The responsibility for deciding what credit to allow for responses not included in the key may safely be placed upon the individual examiner. The error thus introduced cannot be very serious, because any subject's score is made up chiefly of full-credit responses.

*Opposites* may be used as a written test for subjects who greatly prefer written to orally-presented tasks, and especially for deaf subjects; but the test owes its strength largely to the convenience and economy of time with which it may be used for oral presentation.

Whether the form to be used is $A$ or $B$ or $A + B$, the middle section should invariably be presented first; and the responses will serve as a guide

to the examiner in making his choice between the upper and lower scales. Each series is steeply graduated in difficulty, especially Series *A;* and the first and last sections may be considered mutually exclusive. When the responses on the middle section are so nearly perfect as to indicate the use of the upper scale, the words of the last section should be presented in reverse order. This makes it unlikely that the task will be brought to a close with a failure.

Series *A* and Series *B* should be used alternately for a group of subjects who are seated in the same room while waiting for individual examination; and either *A* or *B* may be used for a subject who is likely to be referred later for re-examination. Ordinarily, when there is no need of saving test material for future use, it is recommended that the scale *A* + *B* be used in full. This scale yields a wider spread of scores, and is obviously more trustworthy than either single series.

## E. Summary

The four multiple choice units of Emergency Battery have been slightly standardized without time limit, and can now be used both as timed and untimed tests.

The two *Directions* tests, when given without time limit, have been found useless above the 10-year level; and therefore no norms are offered for them as untimed tests. *Directions B* has been standardized with two-minute timing, and the two-minute test supersedes the test as standardized with one-minute timing.

Norms are offered for six independent scales of *Graduated Opposites*: Series *A,* Series *B,* and Series *A* + *B;* with an upper and lower scale for each. This test is recommended as being exceptionally convenient and economical of time. It is intended primarily for oral presentation, but may be used also as a written test.

The number of cases used in the standardization is very small; but in every instance the natural age-curve has been supplemented and strengthened by an independent curve based upon classification of the subjects according to "mental age."

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*Danvers State Hospital*
*Hathorne, Massachusetts*

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# RESULTS OF A MENTAL SURVEY WITH THE KUHLMANN-ANDERSON INTELLIGENCE TESTS IN WILLIAMSON COUNTY, TENNESSEE*[1]

*Tennessee Department of Public Health*

ALPHONSE CHAPANIS AND W. C. WILLIAMS[2]

The mental survey reported upon in this paper formed part of a mental hygiene study conducted in Williamson County, Tennessee. A detailed account of the purpose of the study and a description of the county have already appeared in a previous report (24). Williamson County is a fairly rich agricultural area located approximately at the geographical center of the State. The 1940 Census gave the population of the county as 25,220 of which 5,625 or 22.3 per cent were Negroes. The area may be described as typically rural; the only incorporated city in the county, the county seat of Franklin, had a population of 4,120 in 1940.

## A. DEFINITION OF THE SAMPLE

The sample of children tested was originally defined as all Williamson County children who on September 1, 1936, were between 6 and 14 years of age and who on May 31, 1937, were resident in the county. Thus, all children born between September 2, 1922, and September 1, 1930, inclusive, constitute the sample.

Certain practical difficulties are inherent in this age definition. For example, a child born on September 1, 1930, would be six years old at the time of test only if he were tested on the census date. Since the major part of the testing was done between September, 1936, and July, 1937, such a child might not have been tested until several months after the census date. He would, therefore, be more than six years old at the time of test. Since mental test scores are distributed in this analysis according to the chrono-

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[1]From the Tennessee Department of Public Health. This investigation was made possible by the financial support of the International Health Division of the Rockefeller Foundation.

[2]This mental survey was undertaken as one phase of the program of the Child Guidance Study in Williamson County under the direction of Dr. W. F. Roth, Jr., Director of the Study. Acknowledgments are made to the field workers who administered the tests, Miss Virginia Kirk, Miss Winifred Zwemer, Miss Helen Gildea, and Dr. Ruth R. Puffer, Director of Statistical Research of the Tennessee Department of Public Health.

logical ages of the examinees at time of testing, the numbers of children appearing in the youngest age groups were considerably less than the numbers of children appearing in the later age groups. A similar situation arose in the case of the 14-year-old children. A child who was 13 years, 11 months old on September 1, 1936, might not have been tested until a year later, so that he would be 14 years, 11 months old at the time of test.

In the routine testing, examiners administered tests to all the children in a school or classroom regardless of age. Among the under-age children about 100 were born later than September 1, 1930, but were over six years old at time of test, and among the over-age children about 200 were born previous to September 2, 1922, but were under 15 years of age at time of test. In order to augment the number of cases in the low and high age groups, the results obtained with these children were combined with those in the sample originally defined. The mean mental ages of these children did not differ significantly from the means of those who fell strictly within the age definition. The inclusion of these cases amounts practically to redefining the sample as all county children who were between 6 and 15 years of age at the time of testing.

Although the effort was made to determine whether or not the individuals tested were living in the county on May 31, 1937, it was extremely difficult to establish residence for all children because of the physical impossibility of visiting every home in a widely scattered rural community. This requirement, therefore, may not hold in a few cases.

### B. Completeness of the Testing

The tests administered to these children were the Kuhlmann-Anderson Intelligence Tests, The Revised Beta Examination, and the Pintner-Cunningham Primary Mental Test. Though retests are available on most of the children, this study deals only with results obtained with the first administration of the Kuhlmann-Anderson Intelligence Tests.

In all, Kuhlmann-Anderson tests were given to 4,311 children, 6 through 14 years of age. In order to determine the completeness of the test program, the population for this age group was estimated for September 1, 1936. The numbers of children tested, with the estimated population, are given for the four race and sex groups in Table A.

A few additional children were given other group tests and a few were tested by individual tests. From these figures, it is evident that the testing program was extended to over 90 per cent of the white children and to 73 per cent of the Negro children in this age group. The scores obtained on

TABLE *A*

| | Number tested | Estimated population | Percentage tested |
|---|---|---|---|
| Total | 4,311 | 4,876 | 88.4 |
| White male | 1,847 | 1,938 | 95.3 |
| White female | 1,654 | 1,833 | 90.2 |
| Negro male | 410 | 557 | 73.6 |
| Negro female | 400 | 548 | 73.0 |

Kuhlmann-Anderson Intelligence tests by these 4,311 children constitute the material for this paper.

In order to have accurate ages for the analysis, a search for exact dates of birth was carried to birth certificate records, family Bible records, etc.

### C. Scoring of the Examinations

The Kuhlmann-Anderson Intelligence Tests include a battery of 39 different tests grouped by tens into nine grade examinations (17). Since they form a continuous graded series, it is possible to administer any desired number of tests to an individual. In a number of cases, more than the usual 10 tests were administered and the results obtained on these additional tests were used in the determination of the final mental age rating.

Every effort was made to insure the accuracy of the scoring. For those tests in which the use of non-verbal items did not allow unequivocal scoring, arbitrary rules were formulated and samples of correct and incorrect responses were used to make the marking as objective and uniform as possible. All the tests were completely rescored. Only one change was introduced in the scoring rules. In test Number 16, which consists of a series of squares and circles differing in size, the instructions to the child state: "Make a cross in the second square and a line over the last circle." Not infrequently the command to "make a line *over* the last circle" was interpreted as meaning "draw a line *across* the last circle." Both responses were called correct.

Zero scores on the tests were fairly common. This is an indication that the tests given were too hard for the children. Because of the method used in obtaining the final rating (the median of the mental ages found on the individual tests), it is possible to lower a child's score by increasing the number of zero test scores he earns through the administration of tests which are too difficult. It was argued, therefore, that zero scores on tests definitely beyond the ability of the child should not be included in the determination of his final rating. If a child earned a zero score on any test, the zero was eliminated if the minimum mental age that could be

earned on that test was higher than his median mental age score computed without the test. For example, a child who took the Grade 3 test scored on each of the sub-tests 12 through 18 and made zeros on sub-tests 19, 20, and 21. His mental age rating, computed on the basis of the first seven tests is 6 years, 6 months. The lowest score which can be attained on tests 19, 20, and 21 is 7 years, 1 month. Since this is higher than the child's mental age rating, these three tests are considered beyond his range of ability and the zero scores are disregarded.

Test scores and supplementary information regarding the individual were coded and the data transferred to Hollerith cards from which the tabulations were prepared by machine.

### D. Relationship between Mental Age and Chronological Age

The major emphasis in the analysis has been placed on the relation between mental age scores and chronological age at time of test. Table 1 shows the statistical constants for the mental age distributions by sex and color. It will be noted that the distributions of mental ages are given for every quarter year of chronological age from 6 to 15 years. Mental age scores

TABLE 1

Statistical Constants for the Distributions by Sex and Color of Mental Ages in Months Earned on the Kuhlmann-Anderson Intelligence Tests by 4,311 Williamson County Children

| Age at time of test | Statistical constants | White | | | Negro | | | All cases |
|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total | |
| 6 yrs., 0 mos. | Number | 41 | 38 | 79 | 8 | 5 | 13 | 92 |
| to | Median | 69.5 | 72.0 | 71.0 | 64.0 | 64.5 | 64.2 | 69.7 |
| 6 yrs., 3 mos. | Mean | 69.6 | 71.5 | 70.5 | 64.5 | 66.6 | 65.3 | 69.8 |
| | *SD* | 8.5 | 8.8 | 8.6 | 8.9 | 9.1 | 8.7 | 8.8 |
| 6 yrs., 3 mos. | Number | 53 | 51 | 104 | 13 | 9 | 22 | 126 |
| to | Median | 71.8 | 72.4 | 72.0 | 60.5 | 61.5 | 60.8 | 69.9 |
| 6 yrs., 6 mos. | Mean | 71.7 | 72.6 | 72.2 | 60.7 | 64.3 | 62.2 | 70.4 |
| | *SD* | 8.5 | 10.3 | 9.4 | 3.9 | 8.4 | 6.2 | 9.7 |
| 6 yrs., 6 mos. | Number | 42 | 50 | 92 | 6 | 8 | 14 | 106 |
| to | Median | 74.7 | 80.0 | 77.7 | 62.0 | 72.0 | 68.0 | 76.6 |
| 6 yrs., 9 mos. | Mean | 73.6 | 78.6 | 76.3 | 63.0 | 72.8 | 68.6 | 75.3 |
| | *SD* | 10.6 | 8.4 | 9.7 | 6.6 | 9.0 | 9.2 | 10.0 |
| 6 yrs., 9 mos. | Number | 46 | 47 | 93 | 15 | 14 | 29 | 122 |
| to | Median | 76.0 | 78.8 | 77.8 | 70.5 | 72.0 | 71.2 | 75.9 |
| 7 yrs., 0 mos. | Mean | 75.1 | 77.9 | 76.6 | 70.2 | 70.3 | 70.2 | 75.0 |
| | *SD* | 10.6 | 9.7 | 10.2 | 9.1 | 10.6 | 9.7 | 10.4 |
| 7 yrs., 0 mos. | Number | 57 | 58 | 115 | 8 | 8 | 16 | 131 |
| to | Median | 75.9 | 78.4 | 77.4 | 66.0 | 66.0 | 66.0 | 76.3 |
| 7 yrs., 3 mos. | Mean | 75.7 | 78.7 | 77.2 | 67.5 | 69.0 | 68.2 | 76.1 |
| | *SD* | 10.3 | 9.6 | 10.0 | 6.2 | 11.1 | 8.7 | 10.3 |

TABLE 1 (*continued*)

| Age at time of test | Statistical constants | White Male | White Female | White Total | Negro Male | Negro Female | Negro Total | All cases |
|---|---|---|---|---|---|---|---|---|
| 7 yrs., 3 mos. to 7 yrs., 6 mos. | Number | 52 | 52 | 104 | 8 | 11 | 19 | 123 |
| | Median | 80.1 | 78.5 | 79.3 | 73.5 | 73.0 | 73.3 | 78.1 |
| | Mean | 78.5 | 78.8 | 78.6 | 69.8 | 71.7 | 70.9 | 77.4 |
| | *SD* | 12.1 | 9.2 | 10.7 | 11.8 | 8.6 | 9.8 | 10.9 |
| 7 yrs., 6 mos. to 7 yrs., 9 mos. | Number | 55 | 56 | 111 | 10 | 13 | 23 | 134 |
| | Median | 80.3 | 84.0 | 82.1 | 68.0 | 74.5 | 72.3 | 80.6 |
| | Mean | 80.2 | 86.4 | 83.3 | 67.2 | 75.0 | 71.6 | 81.3 |
| | *SD* | 8.2 | 11.0 | 10.1 | 7.0 | 9.5 | 9.2 | 10.9 |
| 7 yrs., 9 mos. to 8 yrs., 0 mos. | Number | 59 | 41 | 100 | 9 | 6 | 15 | 115 |
| | Median | 81.8 | 82.8 | 82.2 | 73.5 | 76.0 | 75.0 | 81.4 |
| | Mean | 81.7 | 87.3 | 84.0 | 71.0 | 78.0 | 73.8 | 82.7 |
| | SD | 11.9 | 14.1 | 13.1 | 11.6 | 7.4 | 10.4 | 13.2 |
| 8 yrs., 0 mos. to 8 yrs., 3 mos. | Number | 53 | 58 | 111 | 13 | 14 | 27 | 138 |
| | Median | 82.7 | 88.5 | 86.0 | 79.0 | 75.0 | 78.4 | 84.2 |
| | Mean | 83.8 | 90.7 | 87.4 | 80.5 | 77.1 | 78.8 | 85.7 |
| | *SD* | 13.4 | 14.6 | 14.4 | 7.5 | 12.8 | 10.5 | 14.2 |
| 8 yrs., 3 mos. to 8 yrs., 6 mos. | Number | 59 | 44 | 103 | 12 | 15 | 27 | 130 |
| | Median | 89.6 | 90.0 | 89.8 | 72.0 | 75.8 | 75.0 | 85.8 |
| | Mean | 90.5 | 89.0 | 89.8 | 72.5 | 77.0 | 75.0 | 86.8 |
| | *SD* | 14.6 | 12.2 | 13.6 | 11.0 | 15.5 | 13.6 | 14.8 |
| 8 yrs., 6 mos. to 8 yrs., 9 mos. | Number | 44 | 53 | 97 | 10 | 10 | 20 | 117 |
| | Median | 88.8 | 91.5 | 90.2 | 79.2 | 90.0 | 81.4 | 88.4 |
| | Mean | 89.3 | 93.4 | 91.6 | 78.6 | 87.0 | 82.8 | 90.1 |
| | *SD* | 11.8 | 16.1 | 14.4 | 9.0 | 8.5 | 9.6 | 14.1 |
| 8 yrs., 9 mos. to 9 yrs., 0 mos. | Number | 54 | 51 | 105 | 6 | 15 | 21 | 126 |
| | Median | 90.7 | 101.2 | 95.6 | 84.0 | 84.8 | 84.6 | 93.0 |
| | Mean | 90.9 | 99.0 | 94.8 | 85.0 | 84.2 | 84.4 | 93.1 |
| | *SD* | 15.2 | 14.8 | 15.5 | 10.5 | 13.2 | 12.2 | 15.5 |
| 9 yrs., 0 mos. to 9 yrs., 3 mos. | Number | 50 | 48 | 98 | 15 | 15 | 30 | 128 |
| | Median | 92.5 | 104.0 | 97.3 | 82.2 | 82.2 | 82.2 | 92.9 |
| | Mean | 94.2 | 102.0 | 98.0 | 83.8 | 81.8 | 82.8 | 94.4 |
| | *SD* | 17.4 | 13.2 | 15.9 | 12.4 | 9.3 | 10.8 | 16.2 |
| 9 yrs., 3 mos. to 9 yrs., 6 mos. | Number | 64 | 42 | 106 | 15 | 8 | 23 | 129 |
| | Median | 94.5 | 100.5 | 96.0 | 78.6 | 82.0 | 79.9 | 93.5 |
| | Mean | 95.6 | 100.1 | 97.4 | 79.4 | 84.0 | 81.0 | 94.5 |
| | *SD* | 14.2 | 13.4 | 14.0 | 10.3 | 8.5 | 9.7 | 14.7 |
| 9 yrs., 6 mos. to 9 yrs., 9 mos. | Number | 61 | 46 | 107 | 15 | 13 | 28 | 135 |
| | Median | 100.9 | 103.5 | 102.2 | 83.0 | 95.0 | 91.0 | 99.2 |
| | Mean | 98.9 | 101.7 | 100.1 | 84.6 | 93.9 | 88.9 | 97.8 |
| | *SD* | 14.2 | 16.1 | 15.0 | 16.0 | 12.7 | 15.1 | 15.6 |
| 9 yrs., 9 mos. to 10 yrs., 0 mos. | Number | 47 | 47 | 94 | 14 | 14 | 28 | 122 |
| | Median | 96.5 | 103.1 | 100.0 | 84.0 | 82.0 | 82.8 | 94.4 |
| | Mean | 96.4 | 103.2 | 99.8 | 80.6 | 82.3 | 81.4 | 95.6 |
| | *SD* | 15.8 | 16.6 | 16.4 | 12.3 | 10.0 | 11.1 | 17.2 |

TABLE 1 (*continued*)

| Age at time of test | Statistical constants | White | | | Negro | | | All cases |
|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total | |
| 10 yrs., 0 mos. | Number | 59 | 54 | 113 | 14 | 14 | 28 | 141 |
| to | Median | 104.1 | 108.9 | 106.5 | 84.0 | 104.0 | 92.0 | 104.2 |
| 10 yrs., 3 mos. | Mean | 103.3 | 107.7 | 105.4 | 87.4 | 101.6 | 94.5 | 103.2 |
| | *SD* | 18.0 | 17.2 | 17.6 | 11.4 | 17.7 | 16.3 | 17.9 |
| 10 yrs., 3 mos. | Number | 50 | 51 | 101 | 13 | 14 | 27 | 128 |
| to | Median | 105.3 | 113.6 | 109.8 | 87.0 | 90.0 | 88.2 | 106.0 |
| 10 yrs., 6 mos. | Mean | 106.3 | 113.0 | 109.7 | 89.3 | 93.4 | 91.4 | 105.8 |
| | *SD* | 20.9 | 17.1 | 19.3 | 11.4 | 15.0 | 13.3 | 19.6 |
| 10 yrs., 6 mos. | Number | 46 | 48 | 94 | 20 | 14 | 34 | 128 |
| to | Median | 100.0 | 115.6 | 112.2 | 90.0 | 93.0 | 91.2 | 104.6 |
| 10 yrs., 9 mos. | Mean | 105.6 | 114.8 | 110.3 | 90.9 | 92.1 | 91.4 | 105.3 |
| | *SD* | 21.7 | 14.2 | 18.8 | 10.9 | 14.7 | 12.4 | 19.2 |
| 10 yrs., 9 mos. | Number | 58 | 50 | 108 | 7 | 18 | 25 | 133 |
| to | Median | 109.2 | 114.8 | 112.0 | 87.0 | 94.5 | 92.2 | 108.7 |
| 11 yrs., 0 mos. | Mean | 109.6 | 114.2 | 111.7 | 92.1 | 94.7 | 94.0 | 108.4 |
| | *SD* | 21.2 | 19.1 | 20.3 | 15.7 | 18.8 | 17.7 | 21.0 |
| 11 yrs., 0 mos. | Number | 62 | 38 | 100 | 10 | 8 | 18 | 118 |
| to | Median | 112.0 | 121.2 | 114.6 | 99.0 | 93.0 | 96.0 | 110.7 |
| 11 yrs., 3 mos. | Mean | 109.4 | 116.7 | 112.2 | 99.0 | 94.5 | 97.0 | 109.9 |
| | *SD* | 20.5 | 23.1 | 21.7 | 14.7 | 11.4 | 13.2 | 21.3 |
| 11 yrs., 3 mos. | Number | 51 | 43 | 94 | 11 | 11 | 22 | 116 |
| to | Median | 109.8 | 117.9 | 114.6 | 97.5 | 91.5 | 94.0 | 109.3 |
| 11 yrs., 6 mos. | Mean | 114.2 | 118.0 | 115.9 | 98.4 | 94.6 | 96.6 | 112.2 |
| | *SD* | 22.4 | 18.1 | 20.5 | 16.6 | 17.8 | 16.9 | 21.2 |
| 11 yrs., 6 mos. | Number | 53 | 53 | 106 | 15 | 9 | 24 | 130 |
| to | Median | 115.1 | 117.7 | 116.5 | 89.2 | 93.0 | 90.0 | 111.8 |
| 11 yrs., 9 mos. | Mean | 114.1 | 118.6 | 116.3 | 90.6 | 93.0 | 91.5 | 111.7 |
| | *SD* | 19.5 | 18.3 | 19.0 | 12.8 | 16.2 | 13.8 | 20.5 |
| 11 yrs., 9 mos. | Number | 49 | 63 | 112 | 8 | 22 | 30 | 142 |
| to | Median | 116.2 | 120.3 | 118.9 | 99.0 | 102.0 | 100.5 | 114.4 |
| 12 yrs., 0 mos. | Mean | 117.9 | 121.2 | 119.7 | 96.8 | 101.4 | 100.2 | 115.6 |
| | *SD* | 20.3 | 24.2 | 22.6 | 13.6 | 17.8 | 16.7 | 22.8 |
| 12 yrs., 0 mos. | Number | 48 | 41 | 89 | 19 | 20 | 39 | 128 |
| to | Median | 116.0 | 129.0 | 122.5 | 94.5 | 110.0 | 103.5 | 113.7 |
| 12 yrs., 3 mos. | Mean | 122.0 | 125.5 | 123.6 | 98.4 | 111.0 | 104.8 | 117.9 |
| | *SD* | 26.3 | 24.1 | 25.2 | 22.2 | 19.8 | 21.6 | 25.6 |
| 12 yrs., 3 mos. | Number | 73 | 51 | 124 | 13 | 12 | 25 | 149 |
| to | Median | 118.6 | 129.0 | 122.2 | 105.0 | 99.0 | 102.5 | 118.4 |
| 12 yrs., 6 mos. | Mean | 120.8 | 128.4 | 123.9 | 105.9 | 102.0 | 104.0 | 120.6 |
| | *SD* | 23.8 | 25.6 | 24.7 | 14.7 | 16.5 | 15.4 | 24.5 |
| 12 yrs., 6 mos. | Number | 48 | 49 | 97 | 9 | 7 | 16 | 113 |
| to | Median | 127.0 | 132.5 | 129.0 | 97.0 | 111.0 | 100.0 | 126.3 |
| 12 yrs., 9 mos. | Mean | 125.9 | 132.3 | 129.1 | 97.7 | 114.4 | 105.0 | 125.7 |
| | *SD* | 23.7 | 24.1 | 24.0 | 14.0 | 28.3 | 22.3 | 25.1 |

TABLE 1 (*continued*)

| Age at time of test | Statistical constants | White Male | White Female | White Total | Negro Male | Negro Female | Negro Total | All cases |
|---|---|---|---|---|---|---|---|---|
| 12 yrs., 9 mos. | Number | 45 | 48 | 93 | 11 | 15 | 26 | 119 |
| to | Median | 124.5 | 135.0 | 129.4 | 93.0 | 112.5 | 102.0 | 124.9 |
| 13 yrs., 0 mos. | Mean | 125.5 | 134.5 | 130.2 | 99.0 | 114.6 | 108.0 | 125.3 |
| | *SD* | 25.8 | 26.2 | 26.3 | 24.2 | 22.2 | 23.9 | 27.3 |
| 13 yrs., 0 mos. | Number | 50 | 45 | 95 | 10 | 8 | 18 | 113 |
| to | Median | 130.8 | 131.5 | 131.2 | 99.0 | 108.0 | 104.2 | 126.8 |
| 13 yrs., 3 mos. | Mean | 128.3 | 133.4 | 130.7 | 99.6 | 111.8 | 105.0 | 126.6 |
| | *SD* | 20.5 | 29.0 | 24.9 | 12.8 | 21.9 | 17.9 | 25.7 |
| 13 yrs., 3 mos. | Number | 62 | 45 | 107 | 14 | 9 | 23 | 130 |
| to | Median | 129.0 | 149.0 | 141.8 | 108.0 | 129.0 | 109.0 | 137.1 |
| 13 yrs., 6 mos. | Mean | 127.6 | 149.5 | 136.8 | 108.9 | 119.0 | 112.8 | 132.6 |
| | *SD* | 31.8 | 24.8 | 30.9 | 12.1 | 24.6 | 18.2 | 30.4 |
| 13 yrs., 6 mos. | Number | 57 | 50 | 107 | 13 | 11 | 24 | 131 |
| to | Median | 118.5 | 138.0 | 127.5 | 97.5 | 142.5 | 108.0 | 125.7 |
| 13 yrs., 9 mos. | Mean | 122.7 | 137.3 | 129.5 | 100.8 | 139.9 | 118.8 | 127.5 |
| | *SD* | 26.7 | 25.4 | 27.0 | 15.0 | 24.3 | 27.7 | 27.3 |
| 13 yrs., 9 mos. | Number | 40 | 39 | 79 | 10 | 7 | 17 | 96 |
| to | Median | 134.0 | 148.5 | 141.9 | 102.0 | 133.5 | 121.5 | 137.4 |
| 14 yrs., 0 mos. | Mean | 133.8 | 146.4 | 140.0 | 103.8 | 129.0 | 114.2 | 135.4 |
| | *SD* | 21.7 | 24.0 | 23.6 | 24.5 | 20.8 | 25.7 | 25.8 |
| 14 yrs., 0 mos. | Number | 46 | 36 | 82 | 11 | 7 | 18 | 100 |
| to | Median | 130.5 | 136.5 | 133.2 | 99.0 | 101.0 | 100.5 | 130.0 |
| 14 yrs., 3 mos. | Mean | 131.4 | 135.7 | 133.2 | 109.9 | 109.3 | 109.7 | 129.0 |
| | *SD* | 23.6 | 24.6 | 24.0 | 19.7 | 17.9 | 18.5 | 24.7 |
| 14 yrs., 3 mos. | Number | 40 | 29 | 69 | 10 | 5 | 15 | 84 |
| to | Median | 132.0 | 139.0 | 135.0 | 111.0 | 121.5 | 117.0 | 130.5 |
| 14 yrs., 6 mos. | Mean | 130.4 | 140.0 | 134.4 | 116.4 | 124.2 | 119.0 | 131.6 |
| | *SD* | 28.2 | 26.0 | 27.5 | 16.8 | 21.8 | 18.2 | 26.7 |
| 14 yrs., 6 mos. | Number | 36 | 20 | 56 | 6 | 6 | 12 | 68 |
| to | Median | 141.0 | 150.0 | 144.6 | 108.0 | 129.0 | 114.0 | 139.7 |
| 14 yrs., 9 mos. | Mean | 136.2 | 151.2 | 141.5 | 106.0 | 119.0 | 112.5 | 136.4 |
| | *SD* | 28.0 | 37.6 | 32.3 | 23.2 | 27.5 | 25.2 | 32.9 |
| 14 yrs., 9 mos. | Number | 37 | 19 | 56 | 9 | 5 | 14 | 70 |
| to | Median | 140.1 | 139.5 | 140.0 | 111.0 | 129.0 | 126.0 | 138.0 |
| 15 yrs., 0 mos. | Mean | 140.8 | 138.2 | 139.9 | 115.0 | 136.2 | 122.6 | 136.5 |
| | *SD* | 35.0 | 19.5 | 30.5 | 24.4 | 21.4 | 24.8 | 30.1 |

are expressed as months of mental age to eliminate the unwieldy "years and months" designation. Only the independent statistics, number, mean, median, and standard deviation, are included in the table; constants such as the standard error of the mean and coefficient of relative variability may be readily computed from the data given.

In considering the mental age data, some statement should be made regarding the form of the mental age distributions, particularly as regards

their symmetry. The calculation of elaborate measures of skewness was deemed inadvisable because of the fewness of the cases at any quarter year of chronological age. As a matter of fact, for our purposes it is adequate to indicate whether the distributions tend to show more negative than positive skewness or vice versa. Table 2, accordingly, shows the algebraic signs of the differences (mean-median) for the distributions of mental ages by sex and color. The younger half includes the 18 distributions of individuals 6 years,

TABLE 2

ALGEBRAIC SIGNS OF THE DIFFERENCES (MEAN-MEDIAN) FOR THE DISTRIBUTIONS BY SEX AND COLOR OF MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 4,311 WILLIAMSON COUNTY CHILDREN

| Age group | Algebraic signs | White | | | Negro | | | All cases |
|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total | |
| Younger half | Positive | 8 | 8 | 8 | 12 | 11 | 10 | 11 |
| | Negative | 10 | 10 | 10 | 6 | 7 | 7 | 7 |
| | Equal | — | — | — | — | — | 1 | — |
| Older half | Positive | 10 | 7 | 8 | 15 | 11 | 14 | 8 |
| | Negative | 8 | 11 | 10 | 2 | 6 | 4 | 10 |
| | Equal | — | — | — | 1 | 1 | — | — |
| Total | Positive | 18 | 15 | 16 | 27 | 22 | 24 | 19 |
| | Negative | 18 | 21 | 20 | 8 | 13 | 11 | 17 |
| | Equal | — | — | — | 1 | 1 | 1 | — |

0 months to 9 years, 6 months of age, and the older half includes the 18 distributions of individuals 9 years, 6 months to 15 years, 0 months of age. The mean-median difference forms the basis for the measure of skewness, $Sk_5$, given by Dunlap-Kurtz (6). If the difference is plus, the distribution tends to be positively skewed, i.e., the scores are grouped at the low end of the distribution and spread out gradually toward the high end; a negative difference indicates the opposite.

The figures for the total group would seem to indicate no very great asymmetry: 19 of the 36 differences are plus while 17 are negative. Likewise, the distributions for the white children as a whole tend to show an equal number of positive and negative differences. When the total group of white mental age distributions is compared for the younger and older halves, it is evident that there is no greater skewness for the distributions of the younger children than for the older. It is difficult to evaluate the sex difference found for the white children, although offhand it seems unimportant. In the case of the Negroes, however, there is apparent a consistent tendency for the distributions to be asymmetrical. For the total group of Negroes, 24 of the 36 distributions are positively skewed, 11 are negatively skewed,

and one shows no skewness. The asymmetry appears in the distributions of both younger and older children and for both sexes. The distributions of females, it should be noted, tend to approximate the normal form more closely than do those for the males, this being especially evident in the distributions of the older children. These findings on skewness are consistent with the trends of mean mental ages discussed later. The performance of the Negro children is lower than the performance of the white children and among the Negroes the performance of the boys is lower than that of the girls. If examinations covering identical ranges of ability are administered to children of the same age, then the scores for Negroes fall lower in the distributions and the tests administered are more likely to be too difficult for them or, to state it another way, the scale would probably not extend low enough to sample their ability adequately.

As regards the mental age regressions, Figures 1, 2, and 3 show mean mental ages[3] plotted against chronological age for all children by color, the

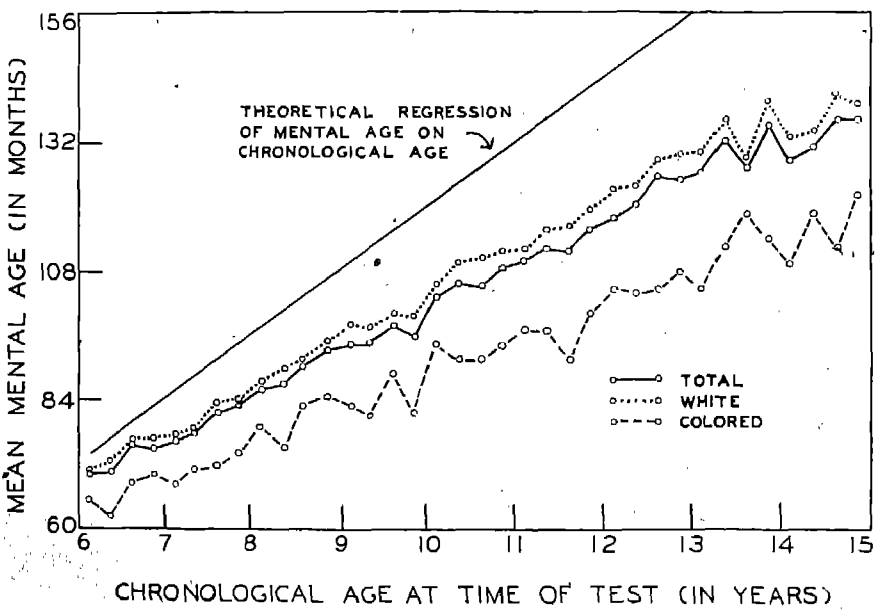


FIGURE 1

MEAN MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 4,311 WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND COLOR

[3]Despite the skewed distributions noted above, regressions of median mental ages differ but slightly from those shown here. Mean values were employed in the analysis because the mean is, in general, a more reliable statistic.

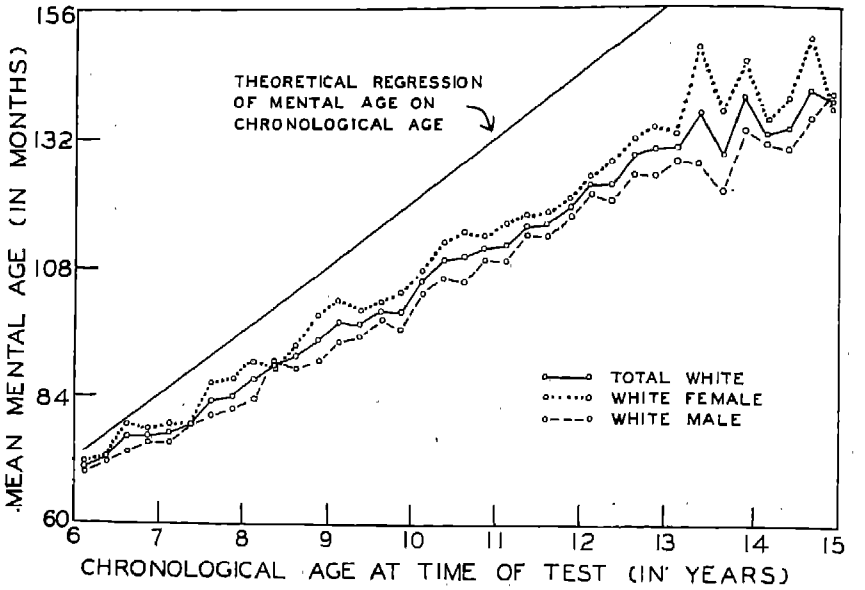


FIGURE 2

MEAN MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 3,501 WHITE WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

white children by sex, and the Negro children by sex. If the data shown in these figures are ranked in the order of highest to lowest performance, they yield the following arrangement: white females, white males, Negro females, and Negro males. More will be said about these differences later. The theoretical regression lines shown in the figures illustrate the mental age scores which should be expected on the basis of the test standardization.

Straight line equations have been fitted to all the curves shown in Figures 1, 2, 3, and analysis of variance techniques have been applied to test the goodness of fit. The constants for the linear equations (means and standard deviations of both variables, the regression coefficient, the standard error of the mean mental age,[4] and the standard error of the regression coefficient)

[4]The standard error of the mean Y is obtained by Fisher's (7) formula: $SE_{M_Y} = \sqrt{\frac{\Sigma(Y-Y')^2}{N(N-2)}}$ where $Y'$ is any value of the dependent variable estimated from the regression equation. The standard error computed from this formula is less than would be found by dividing the standard deviation of the distribution by the square

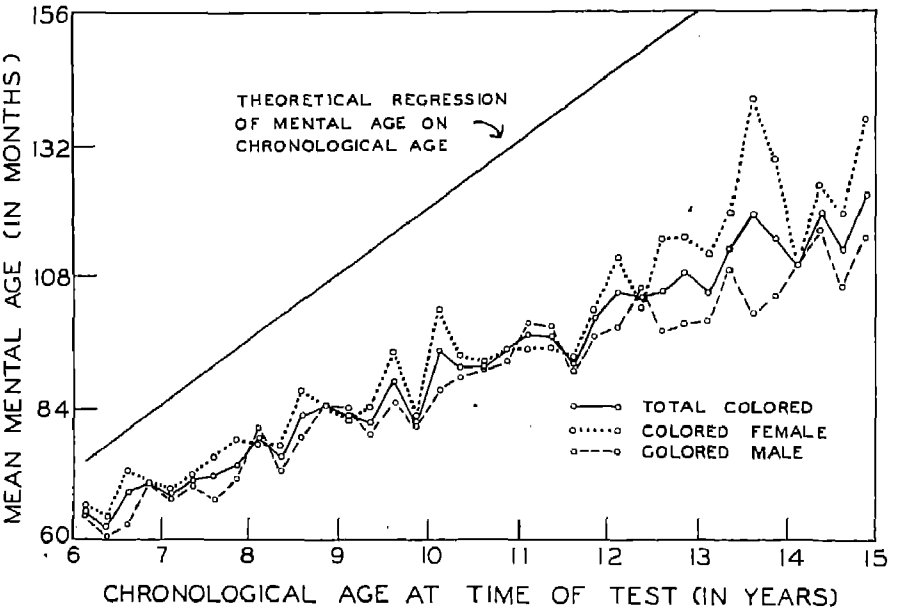


FIGURE 3

MEAN MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 810 NEGRO WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

are shown in Table 3. For two of the seven regressions, the deviations from the linear can be considered significant. The probability is only 0.01 that the white female regression is linear and 0.03 that the Negro female regression is linear. In all other cases the probability exceeds 0.05. Despite the poorness of fit for the two regressions noted above, the data are treated as linear throughout in order to facilitate comparisons.

In this connection, a study of Figures 2 and 3 will show that the major

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root of the number of cases in the distribution, i.e., $\frac{\sigma_Y}{\sqrt{N}}$. The former value, it will be observed, is not merely the sampling variance of the mean $Y$ but the estimate of the sampling variance of the mean of $Y$ for a given value of $X$, this value being taken at or near the mean of the sample and supposed invariable from sample to sample. As stated by Fisher (7), "The distinction, which at first sight appears somewhat subtle, is worth bearing in mind. From a set of measurements of school children, we may make estimates of the mean stature at age ten, and of the mean stature of the school, and these estimates will be equal if the mean age of the school children is exactly ten. Nevertheless, the former will usually be the more accurate estimate, for it eliminates the variance in mean school age, which will doubtless contribute somewhat to the variation in mean school stature."

TABLE 3

STATISTICAL CONSTANTS FOR THE REGRESSIONS BY SEX AND COLOR OF KUHLMANN-ANDERSON MENTAL AGES IN MONTHS ($Y$) ON CHRONOLOGICAL AGE AT TIME OF TEST ($X$) FOR 4,311 WILLIAMSON COUNTY CHILDREN

| Statistical constants | White | | | Negro | | | All cases |
|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | |
| $N$ | 1,847 | 1,654 | 3,501 | 410 | 400 | 810 | 4,311 |
| $M_X$ | 125.01 | 122.85 | 123.99 | 126.33 | 124.35 | 125.35 | 124.25 |
| $\sigma_X$ | 29.98 | 29.61 | 29.82 | 29.44 | 27.73 | 28.60 | 29.60 |
| $M_Y$ | 104.12 | 108.62 | 106.25 | 88.74 | 94.11 | 91.39 | 103.46 |
| $\sigma_Y$ | 28.18 | 29.24 | 28.77 | 20.07 | 23.91 | 22.20 | 28.25 |
| $b_{YX}$ | 0.672 | 0.751 | 0.705 | 0.482 | 0.618 | 0.541 | 0.672 |
| $SE_{M_Y}$ | 0.459 | 0.467 | 0.332 | 0.701 | 0.835 | 0.559 | 0.305 |
| $SE_{b_{YX}}$ | 0.015 | 0.016 | 0.011 | 0.024 | 0.030 | 0.020 | 0.010 |

contribution to the variance representing the deviations of means of arrays from the regression line comes at the years 13 and 14. It may be noted incidentally that the curves for whites are less variable because of the greater number of cases at each point. The cause of the rather wide fluctuations in mean values at these upper ages is difficult to determine. One reason might be an incompleteness of the sample. Table 1 shows that the number of white females tested at age 14 is considerably less than the numbers tested at the other ages. It is, furthermore, quite plausible that some selective factors were operative. It is certain, however, that the linear equations would fit adequately if the means at these two ages were eliminated so that there is reason for stating that the greater part of the data fall along linear regression lines and may be so treated in the analysis.

The statistical procedure for testing the significance of the difference between constant terms of regression equations requires some comment. If we have two regression equations of the form: $Y' = M_Y + b(X - M_X)$, the difference between the regression coefficient, $b_1$ and $b_2$, may be evaluated in terms of the standard error of the difference between them. But the difference between mean $Y$'s can be compared directly only if they fall at the same mean $X$'s, i.e., comparisons between mean mental ages can be affected only if the chronological ages of the two samples are identical. The mean chronological ages ($M_X$) shown in Table 3 differ for each group, hence to equate the mean $Y$'s it is necessary to estimate a mental age from

one of the equations at the average chronological age of the other, i.e., estimate $Y_2$ at $X_2 = M_{X_1}$. The standard error of the mean $Y$, of course, no longer strictly applies to the estimated $Y_2$ but the error involved in using it in this manner is negligible. The difference between the two equated mental ages is finally evaluated in terms of the standard error of the difference.

Differences between certain of the regressions have been tested for significance by means of the above techniques with the following results: the performance of the white children excels that of the Negro children; and the performance of the girls, for both whites and Negroes, is higher than that of the boys. The regression of the white female children, which most nearly approximates the theoretically expected regression, is reliably different from what should be expected on the basis of the test standardization. Of the differences reported, the least reliable is the one between the regression coefficients of Negro males and females. However, the critical ratio or value of $t$, in terms of the standard error of the difference, is 3.51 so that even this small difference is clearly significant.

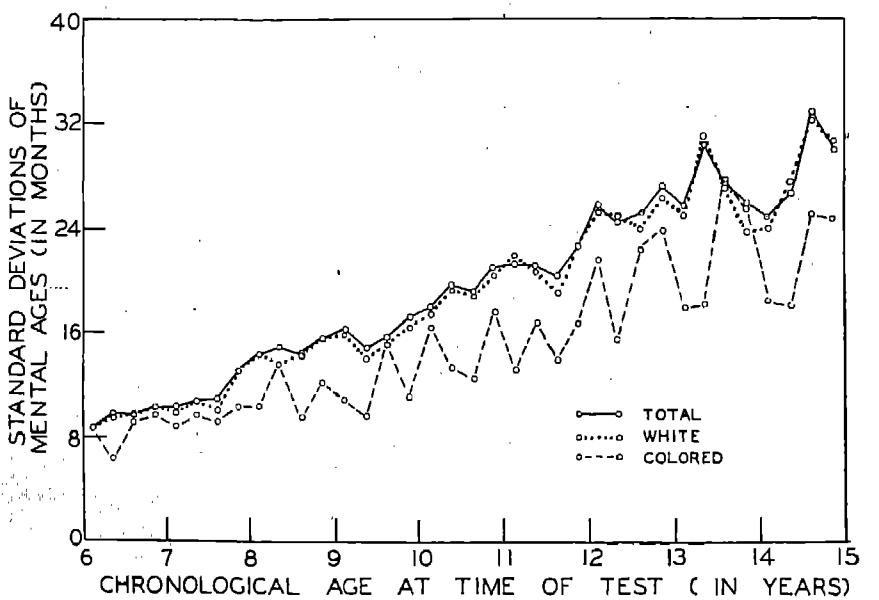


FIGURE 4

STANDARD DEVIATIONS OF MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 4,311 WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

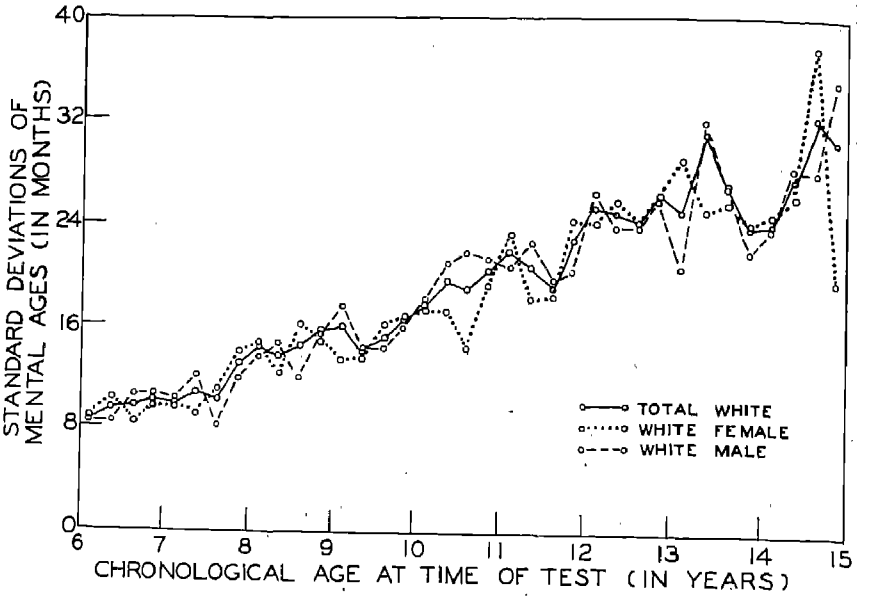


FIGURE 5

STANDARD DEVIATIONS OF MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 3,501 WHITE WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

As would be expected, variability in the mental age scores increases with chronological age. This is demonstrated by Figures 4, 5, and 6 in which standard deviations are plotted for the distributions of mental ages. The significance of any of the differences cannot be evaluated statistically inasmuch as concomitant [illegible] mental ages have already been demonstrated. Thus, the standard deviations of mental age scores for the whites are larger than the corresponding Negro values (Figure 4). To evaluate properly this difference in variability, some account should be taken of the disparity in mean scores between whites and Negroes by resorting to a measure of relative variability. As has been pointed out (8, 28), however, the coefficient of relative variability is unsuited to mental test data for two reasons: first, equality of the units in which performance is measured cannot be demonstrated throughout the entire range; and secondly, no absolute zero in the mental age scale is available.

The variabilities are shown separately for males and females for white and Negro children in Figures 5 and 6. Contrary to what has been reported (23, 27), sex differences in variability of scores are rather small and, for the

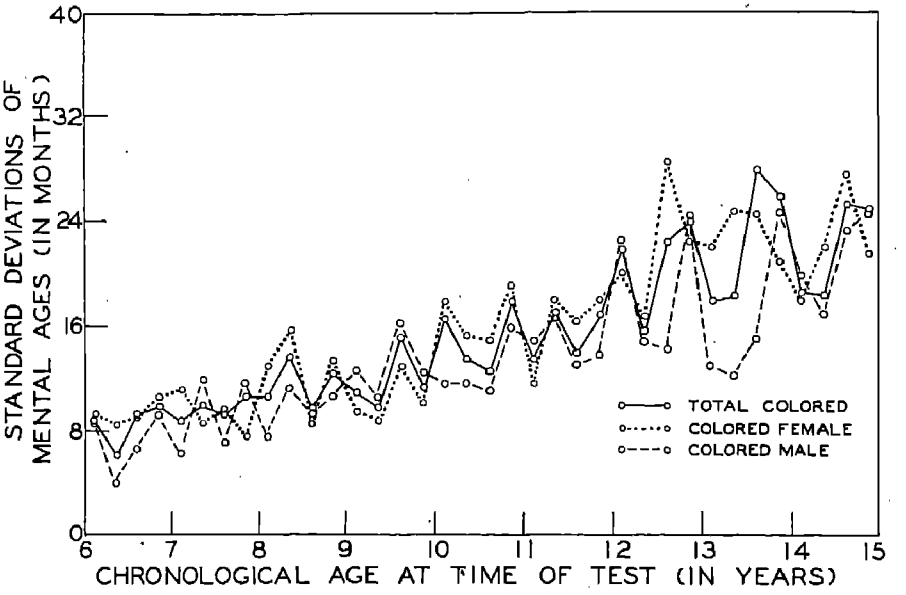


FIGURE 6

STANDARD DEVIATIONS OF MENTAL AGES EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 810 NEGRO WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

white children, practically negligible. Here again, of course, it would be necessary to adjust both curves for the difference in mean scores between males and females. Even when this adjustment is attempted by using the coefficient of relative variability, the result is not unequivocal. Relative variabilities for white males are greater than relative variabilities for white females in 22 distributions, while the reverse is true in 14 of the distributions. Nineteen of the 36 standard deviations are greater for white males and 17 are greater for white females. Comparable figures for the Negroes would indicate greater variability in score for the females: 23 of the 36 female standard deviations exceed the corresponding standard deviations for males, while 22 of the relative variabilities are greater for the females. In the consideration of variabilities of scores for Negroes, the low average scores and positively skewed distributions found for them may be factors causing a reduction in the size of the standard deviations. At any rate, it should be clear that little can be positively stated regarding variability of performance, as contrasted with variability of test scores, other than that it increases with chronological age.

## E. Regression of Intelligence Quotient on Chronological Age

Although mental ages constitute the basic data and the results of the testing can be summarized adequately in those terms, it is also of interest to present the results in the form of intelligence quotients. The statistical constants for the distributions of intelligence quotients by sex and color are given in Table 4. The mean values for the total group by color, the white children by sex and the Negro children by sex are shown in Figures 7, 8, and 9.

TABLE 4

Statistical Constants for the Distributions by Sex and Color of Intelligence Quotients Earned on the Kuhlmann-Anderson Intelligence Tests by 4,311 Williamson County Children

| Age at time of test | Statistical constants | White | | | Negro | | | All cases |
|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total | |
| 6 yrs., 0 mos. | Number | 41 | 38 | 79 | 8 | 5 | 13 | 92 |
| to | Median | 93.0 | 97.0 | 95.6 | 87.0 | 88.2 | 87.6 | 93.7 |
| 6 yrs., 3 mos. | Mean | 94.3 | 96.5 | 95.4 | 88.2 | 89.0 | 88.5 | 94.4 |
| | *SD* | 12.6 | 11.8 | 12.2 | 12.5 | 12.6 | 12.0 | 12.4 |
| 6 yrs., 3 mos. | Number | 53 | 51 | 104 | 13 | 9 | 22 | 126 |
| to | Median | 93.6 | 95.0 | 94.0 | 80.0 | 80.8 | 80.2 | 90.4 |
| 6 yrs., 6 mos. | Mean | 93.5 | 95.0 | 94.3 | 79.7 | 84.8 | 81.8 | 92.1 |
| | *SD* | 11.2 | 13.8 | 12.5 | 4.8 | 10.9 | 8.1 | 12.7 |
| 6 yrs., 6 mos. | Number | 42 | 50 | 92 | 6 | 8 | 14 | 106 |
| to | Median | 92.3 | 99.5 | 97.4 | 79.5 | 91.2 | 84.5 | 96.1 |
| 6 yrs., 9 mos. | Mean | 92.5 | 98.8 | 95.9 | 79.5 | 91.4 | 86.3 | 94.6 |
| | *SD* | 13.5 | 10.5 | 12.3 | 7.6 | 12.1 | 11.7 | 12.6 |
| 6 yrs., 9 mos. | Number | 46 | 47 | 93 | 15 | 14 | 29 | 122 |
| to | Median | 92.0 | 96.6 | 94.9 | 83.2 | 84.5 | 84.0 | 92.2 |
| 7 yrs., 0 mos. | Mean | 91.0 | 95.3 | 93.2 | 84.3 | 84.9 | 84.6 | 91.1 |
| | *SD* | 13.3 | 11.7 | 12.6 | 11.5 | 12.8 | 11.9 | 13.0 |
| 7 yrs., 0 mos. | Number | 57 | 58 | 115 | 8 | 8 | 16 | 131 |
| to | Median | 90.2 | 92.4 | 91.1 | 77.0 | 82.0 | 79.5 | 89.6 |
| 7 yrs., 3 mos. | Mean | 88.4 | 93.1 | 90.8 | 78.2 | 81.4 | 79.8 | 89.4 |
| | *SD* | 12.2 | 11.7 | 12.2 | 7.4 | 12.4 | 10.0 | 12.4 |
| 7 yrs., 3 mos. | Number | 52 | 52 | 104 | 8 | 11 | 19 | 123 |
| to | Median | 90.4 | 89.0 | 89.7 | 85.8 | 83.2 | 84.9 | 88.2 |
| 7 yrs., 6 mos. | Mean | 88.8 | 88.6 | 88.7 | 81.4 | 81.6 | 81.5 | 87.6 |
| | *SD* | 14.0 | 10.3 | 12.2 | 13.2 | 8.8 | 10.5 | 12.2 |
| 7 yrs., 6 mos. | Number | 55 | 56 | 111 | 10 | 13 | 23 | 134 |
| to | Median | 87.0 | 92.0 | 89.2 | 74.5 | 81.6 | 78.9 | 87.4 |
| 7 yrs., 9 mos. | Mean | 87.2 | 93.4 | 90.3 | 74.0 | 81.6 | 78.3 | 88.3 |
| | *SD* | 8.6 | 11.6 | 10.6 | 6.3 | 10.9 | 9.8 | 11.4 |
| 7 yrs., 9 mos. | Number | 59 | 41 | 100 | 9 | 6 | 15 | 115 |
| to | Median | 86.6 | 87.6 | 87.0 | 80.3 | 82.0 | 81.0 | 86.0 |
| 8 yrs., 0 mos. | Mean | 86.0 | 90.9 | 88.0 | 75.9 | 83.7 | 79.0 | 86.8 |
| | *SD* | 12.3 | 15.6 | 13.8 | 11.7 | 6.8 | 10.5 | 13.8 |

TABLE 4 (*continued*)

| Age at time of test | Statistical constants | White Male | White Female | White Total | Negro Male | Negro Female | Negro Total | All cases |
|---|---|---|---|---|---|---|---|---|
| 8 yrs., 0 mos. | Number | 53 | 58 | 111 | 13 | 14 | 27 | 138 |
| to | Median | 85.6 | 92.2 | 88.7 | 80.3 | 77.0 | 79.9 | 86.7 |
| 8 yrs., 3 mos. | Mean | 86.0 | 93.1 | 89.7 | 81.6 | 79.9 | 80.7 | 87.9 |
| | *SD* | 13.7 | 15.0 | 14.8 | 7.2 | 12.8 | 10.3 | 14.4 |
| 8 yrs., 3 mos. | Number | 59 | 44 | 103 | 12 | 15 | 27 | 130 |
| to | Median | 89.2 | 89.5 | 89.3 | 69.5 | 76.0 | 74.9 | 85.8 |
| 8 yrs., 6 mos. | Mean | 90.0 | 88.7 | 89.4 | 71.2 | 76.3 | 74.0 | 86.2 |
| | *SD* | 14.4 | 12.1 | 13.4 | 10.0 | 14.5 | 12.7 | 14.6 |
| 8 yrs., 6 mos. | Number | 44 | 53 | 97 | 10 | 10 | 20 | 117 |
| to | Median | 85.8 | 89.9 | 87.9 | 75.8 | 87.0 | 78.1 | 85.6 |
| 8 yrs., 9 mos. | Mean | 86.3 | 90.4 | 88.6 | 75.5 | 84.5 | 80.0 | 87.1 |
| | *SD* | 11.7 | 15.8 | 14.2 | 6.3 | 7.9 | 8.3 | 13.7 |
| 8 yrs., 9 mos. | Number | 54 | 51 | 105 | 6 | 15 | 21 | 126 |
| to | Median | 86.4 | 94.1 | 90.0 | 79.5 | 78.7 | 79.0 | 88.1 |
| 9 yrs., 0 mos. | Mean | 85.5 | 93.4 | 89.3 | 80.3 | 78.7 | 79.1 | 87.6 |
| | *SD* | 14.2 | 14.0 | 14.6 | 8.8 | 11.3 | 10.4 | 14.4 |
| 9 yrs., 0 mos. | Number | 50 | 48 | 98 | 15 | 15 | 30 | 128 |
| to | Median | 83.9 | 95.4 | 89.1 | 77.0 | 74.0 | 76.2 | 85.1 |
| 9 yrs., 3 mos. | Mean | 86.0 | 93.2 | 89.5 | 78.0 | 75.0 | 76.5 | 86.4 |
| | *SD* | 16.1 | 12.2 | 14.7 | 12.4 | 10.5 | 11.4 | 15.0 |
| 9 yrs., 3 mos. | Number | 64 | 42 | 106 | 15 | 8 | 23 | 129 |
| to | Median | 83.2 | 88.2 | 84.5 | 70.1 | 72.8 | 71.3 | 82.4 |
| 9 yrs., 6 mos. | Mean | 85.0 | 88.6 | 86.4 | 71.3 | 73.9 | 72.2 | 83.9 |
| | *SD* | 12.8 | 11.8 | 12.4 | 9.4 | 8.0 | 8.8 | 13.0 |
| 9 yrs., 6 mos. | Number | 61 | 46 | 107 | 15 | 13 | 28 | 135 |
| to | Median | 87.0 | 88.9 | 88.0 | 73.2 | 80.8 | 76.5 | 85.7 |
| 9 yrs., 9 mos. | Mean | 85.5 | 88.4 | 86.8 | 73.7 | 80.5 | 76.8 | 84.7 |
| | *SD* | 12.9 | 13.7 | 13.3 | 13.6 | 9.4 | 12.1 | 13.6 |
| 9 yrs., 9 mos. | Number | 47 | 47 | 94 | 14 | 14 | 28 | 122 |
| to | Median | 81.6 | 86.3 | 84.1 | 70.3 | 68.2 | 69.5 | 79.5 |
| 10 yrs., 0 mos. | Mean | 81.0 | 86.6 | 83.8 | 68.1 | 68.8 | 68.4 | 80.3 |
| | *SD* | 13.3 | 13.8 | 13.8 | 10.8 | 9.1 | 9.8 | 14.5 |
| 10 yrs., 0 mos. | Number | 59 | 54 | 113 | 14 | 14 | 28 | 141 |
| to | Median | 84.1 | 90.1 | 87.4 | 69.5 | 86.2 | 76.2 | 85.3 |
| 10 yrs., 3 mos. | Mean | 84.7 | 88.6 | 86.6 | 72.4 | 83.8 | 78.1 | 84.9 |
| | *SD* | 14.7 | 13.8 | 14.3 | 9.5 | 14.5 | 13.4 | 14.5 |
| 10 yrs., 3 mos. | Number | 50 | 51 | 101 | 13 | 14 | 27 | 128 |
| to | Median | 85.1 | 90.5 | 88.2 | 72.0 | 74.5 | 73.0 | 85.6 |
| 10 yrs., 6 mos. | Mean | 86.0 | 90.3 | 88.2 | 72.0 | 75.6 | 73.8 | 85.2 |
| | *SD* | 16.4 | 14.3 | 15.4 | 9.4 | 12.3 | 10.9 | 15.7 |
| 10 yrs., 6 mos. | Number | 46 | 48 | 94 | 20 | 14 | 34 | 128 |
| to | Median | 77.8 | 90.6 | 87.7 | 70.8 | 72.0 | 71.2 | 81.8 |
| 10 yrs., 9 mos. | Mean | 82.8 | 89.6 | 86.3 | 71.0 | 71.6 | 71.3 | 82.3 |
| | *SD* | 17.4 | 10.7 | 14.7 | 8.4 | 12.6 | 10.2 | 15.2 |

TABLE 4 (*continued*)

| Age at time of test | Statistical constants | White Male | White Female | White Total | Negro Male | Negro Female | Negro Total | All cases |
|---|---|---|---|---|---|---|---|---|
| 10 yrs., 9 mos. to 11 yrs., 0 mos. | Number | 58 | 50 | 108 | 7 | 18 | 25 | 133 |
| | Median | 83.5 | 87.6 | 85.9 | 67.0 | 73.2 | 71.4 | 83.3 |
| | Mean | 83.6 | 87.3 | 85.3 | 70.6 | 72.6 | 72.0 | 82.8 |
| | *SD* | 16.2 | 14.3 | 15.4 | 11.8 | 13.9 | 13.2 | 15.8 |
| 11 yrs., 0 mos. to 11 yrs., 3 mos. | Number | 62 | 38 | 100 | 10 | 8 | 18 | 118 |
| | Median | 83.9 | 90.5 | 85.9 | 74.5 | 72.0 | 73.2 | 83.1 |
| | Mean | 81.8 | 86.9 | 83.8 | 74.5 | 70.8 | 72.8 | 82.1 |
| | *SD* | 15.4 | 17.3 | 16.2 | 10.9 | 9.5 | 10.2 | 15.9 |
| 11 yrs., 3 mos. to 11 yrs., 6 mos. | Number | 51 | 45 | 94 | 11 | 11 | 22 | 116 |
| | Median | 80.1 | 86.6 | 83.8 | 70.8 | 65.8 | 67.8 | 79.5 |
| | Mean | 83.6 | 86.3 | 84.8 | 72.0 | 69.3 | 70.6 | 82.1 |
| | *SD* | 16.7 | 13.5 | 15.3 | 11.8 | 12.5 | 12.0 | 15.7 |
| 11 yrs., 6 mos. to 11 yrs., 9 mos. | Number | 53 | 53 | 106 | 15 | 9 | 24 | 130 |
| | Median | 82.4 | 85.2 | 84.0 | 64.0 | 67.0 | 64.5 | 80.2 |
| | Mean | 81.8 | 84.6 | 83.2 | 66.0 | 67.6 | 66.6 | 80.1 |
| | *SD* | 14.2 | 13.6 | 13.9 | 9.5 | 11.3 | 10.0 | 14.8 |
| 11 yrs., 9 mos. to 12 yrs., 0 mos. | Number | 49 | 63 | 112 | 8 | 22 | 30 | 142 |
| | Median | 81.3 | 84.7 | 83.1 | 67.8 | 70.8 | 69.5 | 80.1 |
| | Mean | 82.1 | 85.1 | 83.8 | 67.6 | 70.9 | 70.0 | 80.9 |
| | *SD* | 14.7 | 16.5 | 15.8 | 9.8 | 12.8 | 12.0 | 16.0 |
| 12 yrs., 0 mos. to 12 yrs., 3 mos. | Number | 48 | 41 | 89 | 19 | 20 | 39 | 128 |
| | Median | 80.8 | 89.0 | 85.4 | 65.8 | 72.8 | 70.0 | 78.4 |
| | Mean | 84.1 | 86.4 | 85.2 | 67.8 | 75.5 | 71.7 | 81.1 |
| | *SD* | 18.3 | 16.5 | 17.4 | 14.9 | 13.8 | 14.7 | 17.7 |
| 12 yrs., 3 mos. to 12 yrs., 6 mos. | Number | 73 | 51 | 124 | 13 | 12 | 25 | 149 |
| | Median | 79.8 | 87.6 | 82.6 | 71.4 | 67.0 | 69.1 | 79.4 |
| | Mean | 80.8 | 86.9 | 83.3 | 71.2 | 69.5 | 70.4 | 81.2 |
| | *SD* | 16.2 | 17.0 | 16.7 | 9.5 | 12.2 | 10.7 | 16.6 |
| 12 yrs., 6 mos. to 12 yrs., 9 mos. | Number | 48 | 49 | 97 | 9 | 7 | 16 | 113 |
| | Median | 83.2 | 86.4 | 84.8 | 65.1 | 72.0 | 66.5 | 82.8 |
| | Mean | 82.9 | 87.2 | 85.1 | 65.3 | 75.6 | 69.8 | 82.9 |
| | *SD* | 15.5 | 16.0 | 15.8 | 9.4 | 18.6 | 14.6 | 16.5 |
| 12 yrs., 9 mos. to 13 yrs., 0 mos. | Number | 45 | 48 | 93 | 11 | 15 | 26 | 119 |
| | Median | 78.9 | 88.2 | 83.8 | 58.9 | 73.2 | 67.0 | 80.8 |
| | Mean | 81.1 | 87.5 | 84.4 | 63.8 | 74.7 | 70.1 | 81.3 |
| | *SD* | 16.9 | 17.5 | 17.4 | 16.2 | 14.5 | 15.9 | 18.0 |
| 13 yrs., 0 mos. to 13 yrs., 3 mos. | Number | 50 | 45 | 95 | 10 | 8 | 18 | 113 |
| | Median | 83.1 | 83.2 | 83.2 | 62.8 | 69.5 | 66.2 | 80.8 |
| | Mean | 81.9 | 84.6 | 83.2 | 62.5 | 72.0 | 66.7 | 80.5 |
| | *SD* | 13.3 | 18.2 | 15.8 | 8.0 | 14.1 | 11.8 | 16.4 |
| 13 yrs., 3 mos. to 13 yrs., 6 mos. | Number | 62 | 45 | 107 | 14 | 9 | 23 | 130 |
| | Median | 81.2 | 91.8 | 87.8 | 66.2 | 82.0 | 67.6 | 85.3 |
| | Mean | 80.5 | 92.6 | 85.6 | 67.7 | 74.8 | 70.5 | 82.9 |
| | *SD* | 19.1 | 15.6 | 18.6 | 8.3 | 15.2 | 11.7 | 18.5 |

TABLE 4 (*continued*)

| Age at time of test | Statistical constants | White Male | White Female | White Total | Negro Male | Negro Female | Negro Total | All cases |
|---|---|---|---|---|---|---|---|---|
| 13 yrs., 6 mos. | Number | 57 | 50 | 107 | 13 | 11 | 24 | 131 |
| to | Median | 71.4 | 84.5 | 78.7 | 60.1 | 88.2 | 64.5 | 77.2 |
| 13 yrs., 9 mos. | Mean | 74.9 | 83.7 | 79.0 | 61.6 | 86.1 | 72.8 | 77.9 |
| | *SD* | 16.8 | 15.6 | 16.8 | 9.0 | 15.0 | 17.2 | 16.9 |
| 13 yrs., 9 mos. | Number | 42 | 41 | 83 | 10 | 7 | 17 | 100 |
| to | Median | 80.9 | 89.2 | 85.3 | 62.0 | 80.8 | 73.2 | 83.0 |
| 14 yrs., 0 mos. | Mean | 80.0 | 87.4 | 83.6 | 61.5 | 78.4 | 68.5 | 81.0 |
| | *SD* | 13.7 | 14.9 | 14.7 | 14.4 | 12.8 | 15.9 | 15.9 |
| 14 yrs., 0 mos. | Number | 44 | 34 | 78 | 11 | 7 | 18 | 96 |
| to | Median | 77.0 | 82.8 | 79.5 | 62.0 | 62.0 | 62.0 | 76.5 |
| 14 yrs., 3 mos. | Mean | 77.8 | 81.3 | 79.3 | 64.7 | 64.9 | 64.8 | 76.6 |
| | *SD* | 14.6 | 15.0 | 14.8 | 11.0 | 11.1 | 10.7 | 15.2 |
| 14 yrs., 3 mos. | Number | 40 | 29 | 69 | 10 | 4 | 14 | 83 |
| to | Median | 74.5 | 80.1 | 78.2 | 64.5 | 72.0 | 67.0 | 75.6 |
| 14 yrs., 6 mos. | Mean | 74.9 | 80.8 | 77.4 | 67.5 | 73.2 | 69.1 | 76.0 |
| | *SD* | 16.5 | 15.0 | 16.0 | 9.6 | 14.4 | 10.9 | 15.5 |
| 14 yrs., 6 mos. | Number | 36 | 20 | 56 | 6 | 5 | 11 | 67 |
| to | Median | 80.0 | 87.0 | 81.3 | 64.5 | 75.8 | 67.0 | 79.1 |
| 14 yrs., 9 mos. | Mean | 77.3 | 85.8 | 80.3 | 60.3 | 69.0 | 64.3 | 77.7 |
| | *SD* | 16.0 | 19.9 | 17.8 | 12.5 | 16.0 | 14.2 | 18.2 |
| 14 yrs., 9 mos. | Number | 37 | 19 | 56 | 9 | 4 | 13 | 69 |
| to | Median | 78.0 | 78.2 | 78.1 | 63.2 | 69.5 | 68.2 | 75.6 |
| 15 yrs., 0 mos. | Mean | 79.3 | 78.0 | 78.9 | 64.2 | 72.0 | 66.6 | 76.6 |
| | *SD* | 19.3 | 11.7 | 17.0 | 14.2 | 7.1 | 12.7 | 16.9 |

A study of the charts reveals that the intelligence quotients decrease as the children grow older and that they decrease more rapidly at the younger ages, i.e., the intelligence quotient regressions are typically non-linear. The equations describing these curves may, however, be derived rationally from the empirical equations for mental ages. The actually observed regression of mental age on chronological age is $Y' = k + bX$ where $Y'$ represents values of mental ages predicted from the regression equation and $X$ represents the chronological age of the child. Since the intelligence quotient is a ratio of mental age to chronological age, $IQ = \dfrac{k + bX}{X} = \dfrac{k}{X} + b$ where $k = M_Y - bM_X$.

Certain deductions may be made regarding the behavior of the $IQ$ as a function of chronological age. As $X$ increases indefinitely, $\dfrac{k}{X}$ vanishes and $IQ$ approaches $b$. This means that the curve becomes asymptotic to the value $b$, or, as the chronological age of the children increases, the corresponding mean

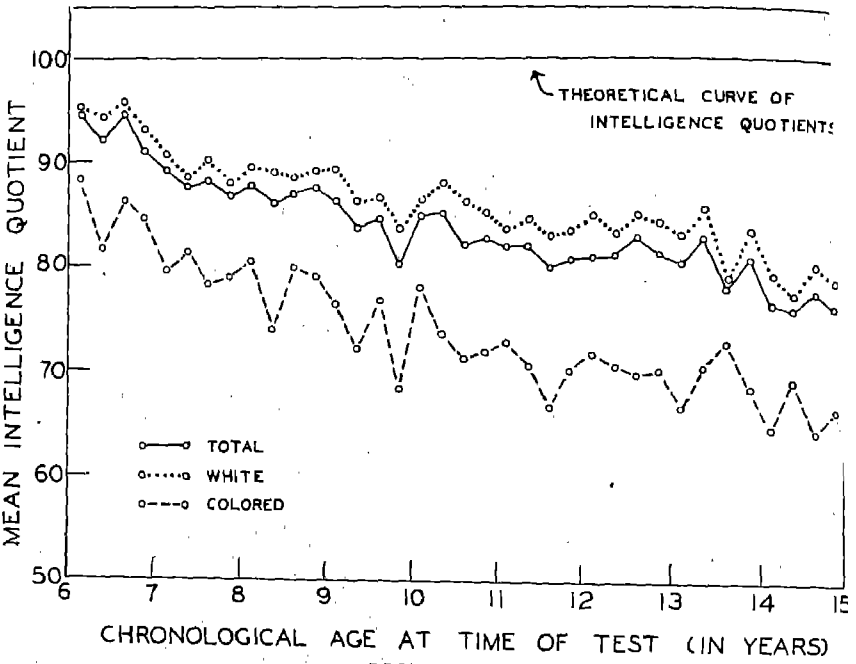


FIGURE 7

MEAN INTELLIGENCE QUOTIENTS EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 4,311 WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND COLOR

$IQ$'s will approach the constant numerical value of the coefficient representing the regression of mental age on chronological age. The first derivative of $IQ$ as a function of $X$ is $\frac{dY}{dX} = -\frac{k}{X^2}$ when $k$ is positive and the second derivative is $\frac{d^2Y}{dX^2} = \frac{2k}{X^3}$. These derivatives state mathematically that the curve has a negative slope and is positively accelerated. Hence, the $IQ$ regressions start at some value higher than $b$ and as the age of the children increases, the mean $IQ$'s decrease rapidly at first and then more slowly until they approach the value $b$. The rational equations for the data by sex and color are given in Table 5. As might be expected, these equations fit the $IQ$ data no worse than the linear equations fit the mental age data.

The procedure of analysis adopted here with its major emphasis on the relationship between mental age and chronological age rather than on the relationship between the intelligence quotient and chronological age is, in

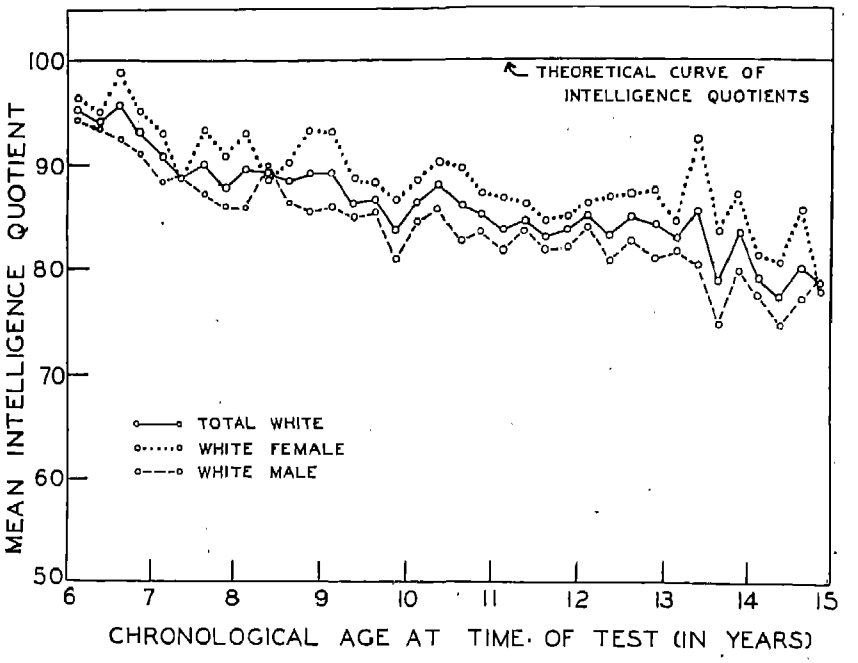


FIGURE 8

MEAN INTELLIGENCE QUOTIENTS EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 3,501 WHITE WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX.

the authors' opinion, significant. It can be demonstrated mathematically that the curve of regression of intelligence quotient on chronological age may assume any of a number of different forms, and that only for the special situation where the regression of mental age on chronological age can be represented by $MA = CA$ does the intelligence quotient curve become horizontal at 100 for all ages. For example, if the equations of the mental data were altered only to the extent of making the $k$ of the linear equations minus instead of plus, the $IQ$ curves would start at a value *less* than $b$, and *increase* with age becoming asymptotic to the value $b$; if $k$ were made equal to zero, the $IQ$ curve would be horizontal at the value of $b$. Several other forms are possible by setting $b$ equal to a value greater than one and the possible variations of $IQ$ curves for non-linear regressions of mental ages are limitless.

The mental age data, thus, are really the more basic and the use of intelligence quotient curves may actually be misleading because they are so easily

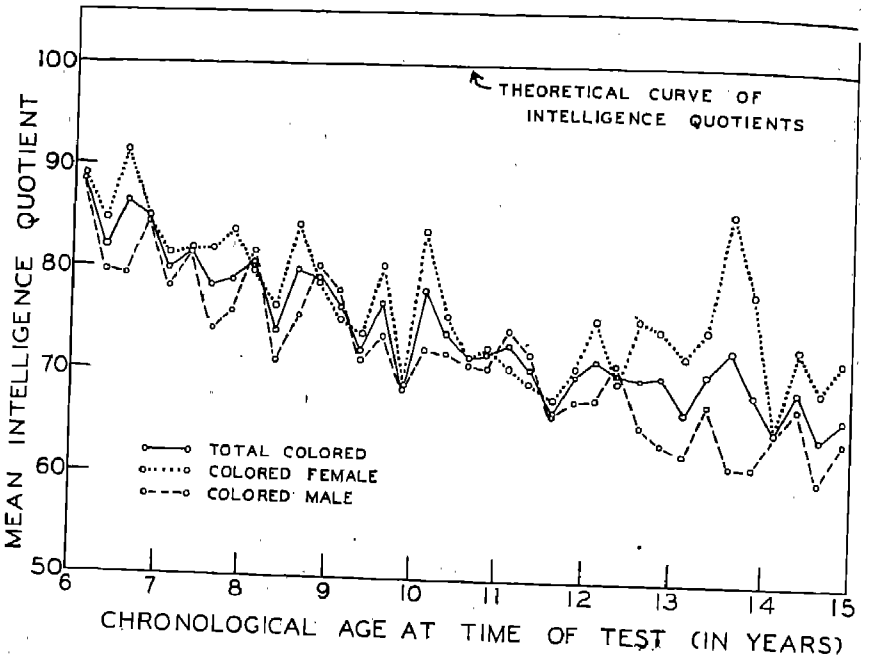


FIGURE 9

MEAN INTELLIGENCE QUOTIENTS EARNED ON THE KUHLMANN-ANDERSON INTELLIGENCE TESTS BY 810 NEGRO WILLIAMSON COUNTY CHILDREN ACCORDING TO CHRONOLOGICAL AGE AND SEX

misinterpreted. Thus, the decreasing *IQ* too often is thought to indicate decreasing intelligence although such an interpretation is obviously incorrect. If mental age scores reflect mental growth independent of environmental and cultural opportunities, there is evidence here that mental development continues throughout the age range of 6 to 15 years, but that it increases slower than for the group on which these tests were standardized, i.e., northern children.

Differences reported between the two sexes and between whites and Negroes in the mental age findings are, naturally, substantiated by the intelligence quotient data. Because of the fact that the regressions of intelligence quotient on chronological age are not linear, the demonstration of the significance of these differences by statistical techniques becomes involved and is not discussed in this paper.

An increase in the variability of intelligence quotients with increases in chronological age as well as sex and race differences in the variability quo-

TABLE 5

RATIONAL EQUATIONS FOR THE KUHLMANN-ANDERSON INTELLIGENCE QUOTIENT REGRESSIONS DERIVED FROM EMPIRICAL MENTAL AGE EQUATIONS

| | |
|---|---|
| White males: | $IQ = \frac{20.1}{CA} + 0.672$ |
| White females: | $IQ = \frac{16.4}{CA} + 0.751$ |
| Total whites: | $IQ = \frac{18.8}{CA} + 0.705$ |
| Negro males: | $IQ = \frac{27.8}{CA} + 0.482$ |
| Negro females: | $IQ = \frac{17.3}{CA} + 0.618$ |
| Total Negro: | $IQ = \frac{23.5}{CA} + 0.541$ |
| All cases: | $IQ = \frac{19.9}{CA} + 0.672$ |

tients can be demonstrated. As in the case of the mental ages, however, it is impossible to evaluate properly such differences as are found. Charts showing the standard deviations of the intelligence quotient distributions are not shown for this reason although the data are available in Table 4.

### F. LIMITATIONS OF THE DATA

The significance of the results of any research depends to a large extent on the validity of the techniques used and the degree of success attained in the control of variables which might affect the results but which are unrelated to the purpose of the study. Although it is obviously impossible to achieve perfection in this regard, recognition of the major defects of experimental procedures is essential for the proper evaluation of data.

One of the largest uncontrolled variables in this research concerns the adequacy of rapport between examiner and testee. It has been recognized by many writers that subtle attitudes and biases of subjects toward the persons conducting experiments or examinations influence the performance of the subjects. Hence, the fact that the examiners in the testing program were not natives of this section and had a manner of speech differing from the speech to which the rural children were accustomed may have caused

an attitude of resistance on the part of some of the children in addition to causing some difficulty in the understanding of directions. Presumably, this factor might be more important with the Negro children since the examiners were white. Although inadequate rapport undoubtedly would have affected the children's scores, there is no way of measuring the possible effect of this factor.

A second limitation of the research is inherent in the tests administered. The lowest possible mental age rating which can be earned with one correct response is 4 years 3 months, i.e., 51 months, so that there are no scores in the interval between zero and 51 months. One should, of course, expect a few cases with mental age scores in this interval since a mental age of 51 months yields an $IQ$ of 71 for a child six years old. It is difficult to measure precisely how important this factor is in relation to the results of this study, but it seems likely that the scores at age six are too high, resulting in a positive $k$ in the mental age equations. Logically, $k$ should be zero or perhaps even minus, in which case, as was indicated earlier, the $IQ$ regressions would be quite different in form.

Lastly, theoretical considerations relating to problems of test construction raise some important points in the interpretation of these results. Two defects in the test are that it does not insure equality of the units throughout the scale nor does it afford an absolute zero. The full ramifications of these limitations have never been completely explored although Franzen (8), McGregor (18) Scates (25), and Thurstone (28) have touched on the problem and have shown the logical implications for mental testing. We have already pointed out that the coefficient of relative variability is unsuited to numerical values which have no absolute zero, and it seems quite logical that when equality of units cannot be demonstrated, such statistical constants as the mean and standard deviation are invalid. Computing a mean for intensive, but non-additive, i.e., unequal, magnitudes may be compared to computing a mean from grouped data in which the step interval varies continuously. Furthermore, the fact that the mental age regressions have been found linear means that in so far as test scores are concerned equal increments of chronological age are accompanied by equal increments in mental age scores. This does not, however, justify the conclusion that the growth of intelligence of these children is constant, unless it can prove that one month of mental age represents the same amount of mental development anywhere along the mental age scale.

## G. Comparisons with Other Studies

Considerable evidence has been accumulating regarding geographical, racial, and sex differences in mental test performance and it is interesting to relate these findings with the results given here. Perhaps the earliest work on geographical differences is the monumental study done with the Army Intelligence Test (31). In this and in the subsequent analysis of the test results by states, it was found that recruits from the northern states yielded higher average scores than did recruits from the southern states. Alexander (1) found that when the median alpha scores were computed for 41 states, Tennessee ranked 34th. That this rank may have changed in the intervening period owing to changes in economic conditions and educational opportunities is quite probable. In another study, Pintner (20) has found that the west north central, Pacific, and west mountain regions have the highest norms on his test while the south Atlantic and west south central are generally lowest.

Comparisons between urban and rural areas are extremely numerous and it is unnecessary to cite all of the studies on this topic. A few of the more important ones are the studies of Book (4), Pintner (19), Pressey and Thomas (21), Pyle and Collings (22), Kempf and Collins (14), Irion and Fisher (12), and Hinds (10). Rural children test consistently lower than urban children on the intelligence examinations now available. Not only is this true of our own country but it has been demonstrated in France, Germany, and Italy by Klineberg (15). Various interpretations have been given to these data but the one which is currently accepted by most authorities is that these tests do not only reflect innate differences in intelligence but also mirror the cultural, social, and educational opportunities of the people in these various geographical areas.

A crucial study in this regard is Shimberg's (26). She devised and standardized very carefully two different information tests, one for an urban population and the other for a rural population. When these were administered to both urban and rural groups, the usual results were found for the test standardized on the urban population; on the other test, however, i.e., the test which was specifically designed for a rural population, the country children yielded the higher scores. This work demonstrates that urban-rural differences may depend partly on the content of the test. Shimberg also indicated that in the standardization of very few tests has any attention been paid to the social or racial composition of the groups tested and that in most standardizations individuals living in northern urban communities are used.

Results of mental surveys performed on groups of relatively isolated mountain children have yielded some of the lowest performances in the country. For example Asher (3) found that the *IQ*'s of his sample of Kentucky mountain children decreased from 83 at age seven to approximately 61 at age 15; Wheeler (29) found that the *IQ*'s of East Tennessee mountain children decreased from 95 at age five and six to 73 at age 15 and 16; and comparable figures given by Hirsch (11) for southeastern Kentucky mountain children are 87 at age five and six and 81 at age 15 and 16. Our results fall somewhere between the theoretically expected results and the findings reported by Asher, Hirsch, and Wheeler for East Kentucky and East Tennessee mountain children.

Divergencies found between the performance of whites and Negroes have been demonstrated before. The earliest findings in this regard, the work of the Army Examining Board (31), indicate that although Negroes tested lower than whites, northern Negroes approximated the white performance much more closely than did the southern Negroes. Klineberg (16) has been particularly interested in the hypothesis that selective migration may account for this difference between southern and northern Negroes. Two conclusions reached by Klineberg in his work are: (*a*) that the intelligence of families migrating to the north does not differ substantially from the intelligence of families not migrating, and (*b*) the mental test performance of children of migratory Negro families increased for a number of years after being placed in northern schools. In an excellent review of the problem of the mental ability of the American Negro, Jenkins (13) concludes that the hypothesis of racial differences in innate intelligence has not been proven because "intelligence test scores reflect both environmental and hereditary factors" and "differences between the average test scores of white and Negro groups may be attributable, either in whole or in part, to the environmental factor."

The whole question of sex differences in mental test performance has never been adequately settled. Anastasi (2) and Gilliland and Clark (9), in summarizing current opinion, indicate that such differences as are found are due partly to the content of the tests administered and to the geographical areas in which the children are tested. Canady's (5) results on Negro college freshmen and Whipple's (3) results on high school students are typical. They found that the females earned higher scores on tests using verbal items whereas males earned higher scores on tests of numerical ability and general information. Since no content analysis of the Kuhlmann-Anderson test was attempted, no explanation is offered to account for the sex

differences in our data. Conclusions regarding sex differences in variability await the development of more adequate statistical techniques and the use of more rigid definitions and selection of individuals.

The differences found between geographical areas and racial and sex groups do not in any way invalidate intelligence test results for comparisons between individuals in any given culture. As long as individuals have had equal social and educational opportunities, mental test results are comparable. However, the implications of Shimberg's (26) results, as we have noted, are that items designed to test the kind of knowledge characteristic of one group of children may not be efficient for another group. The solution of this problem could be attained only through an item analysis of the test used.

## H. Summary and Conclusions

1. A sample of southern children, defined as all Williamson County children who at the time of test were between 6 and 15 years of age, was tested with the Kuhlmann-Anderson Intelligence tests. This sample includes 4,311 children: 1,847 white males, 1,654 white females, 410 Negro males, and 400 Negro females.

2. Since mental age scores are the more basic data, the major emphasis in the analysis is placed on the relationship between mental age and chronological age.

3. The regressions of mental age on chronological age by sex and color are found to be linear.

4. Average performances of the various sex and color groups arranged in the order of highest to lowest are: white females, white males, Negro females, and Negro males.

5. The difference between the performance of the white and Negro children is statistically significant.

6. Sex differences in average performance for both whites and Negroes are reliable with the girls yielding the higher scores in both cases.

7. The performance of the white females most closely approximates what should be expected on the basis of test standardization although their scores still differ reliably from the theoretical performance.

8. Variability in score increases with chronological age at time of test.

9. Sex and racial differences are found in the variability of mental test scores, but this finding cannot be interpreted as indicating fundamental differences in the variability of mental performance between the sexes or races. To test the hypothesis that one group is basically more variable than another group, some account should be taken of the disparities between the mean

performances of these groups. No adequate statistical technique is now available for doing this.

10. Curves showing the relationship between intelligence quotient and chronological age have a negative slope and are positively accelerated, becoming asymptotic to the value of the coefficient representing the regression between mental age and chronological age. The equations for these curves are derived rationally from the empirical equations found for the mental age data.

11. The average performance of Williamson County children is less than that of the children on whom the tests were standardized but is higher than reported for East Tennessee and East Kentucky mountain children. Average scores for children in this and other geographical areas vary in a manner consistent with the hypothesis that mental test performance reflects to a considerable extent the social and economic advantages of the children tested.

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*Department of Public Health*
*420 Sixth Avenue, N.*
*Nashville, Tennessee*

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# PERFORMANCE OF FIFTH, EIGHTH, AND ELEVENTH GRADE CHILDREN IN THE PORTEUS QUALITATIVE MAZE TESTS*[1]

*New Hampshire State Hospital, Concord, New Hampshire*

MARGARET H. SANDERSON[2]

## A. INTRODUCTION

In 1915, Porteus published a test designed to measure "'planning capacity and prudence'" and to supplement the Binet as a measure of intelligence. The new test was introduced with the statement that there was at that time, "an urgent need for a series of tests which will put to the proof the capacities of prudence, forethought, mental alertness, and power of sustained attention" (1, p. 7). The test consisted of 10 mazes of varying difficulty. The mazes were scored according to the number of trials necessary for successful completion, and the resultant score translated into a *TQ*, or Test Quotient rating.

The test has several advantages. It correlates highly with the Binet; and the directions are simple and can be given, if necessary, in pantomime. The test can be administered and scored in a short time, and the materials are light and easy to transport. Further, rapport can be established rapidly because the mazes capture the interest of both children and adults.

In 1942, Porteus published a new book, *Qualitative Performance in the Maze Test* (1). This book was the result of 25 years of research into the use of the Maze Test as indicative of certain temperamental traits. In this study it was discovered that individuals differed widely in the quality of their performances.

In the presentation of the mazes, the subject's attention is directed to the task of finding the exit in the maze without falling into traps. Since there is no warning about the quality of performance, established work-habits are given ample opportunity to appear. For example, the careful, accurate person will probably work cautiously and precisely; the slovenly, careless person will probably do hurried, haphazard work. Because the subject is "off guard," these traits become easily apparent.

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[1]This study was conducted at MacMurray College, Jacksonville, Illinois, under the supervision of Dr. Henry M. Halverson.

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To establish the validity of his assumption that work-habits in the Maze are related to habits of action in other fields of social and personal relationships, Porteus made a study of the Maze reactions of groups of people obviously deficient in social prudence and compared their scores with those of presumably normal people. On the basis of a comparison of the number of errors made by a preliminary group of delinquents and non-delinquents, a system of numerical weightings was devised for some of the significant points of difference in qualitative performance. These differences were brought into sharp relief by slight changes in the directions for administering the test, especially in regard to lifting the pencil, crossing lines, and cutting corners.

In the new directions, warning against each of the qualitative errors is given verbally or implied in the examiner's actions. The heaviest penalty, a weighting of three for each error, is allotted for lifting the pencil. Errors with a weighting of two include failures in the first third of the test, crossed or touched lines, and wavy lines. Cut corners, attempts to go in the wrong direction, and failure in the last third of the test or in the first two mazes have a weighting of one.

To establish norms for qualitative scoring, Porteus used six groups of subjects all over 14 years of age, 100 in each group: non-feebleminded delinquent boys, non-feebleminded delinquent girls, normal boys, normal girls, adult criminals, and normal adult bus drivers. In comparing incidence of qualitative errors and weighted scores of the delinquent and non-delinquent groups, it was found that in each case, the delinquent group scored more than twice as many errors as did the non-delinquent group. Correlations between Binet scores and qualitative Maze scores indicated that intelligence as measured by the Binet, is not a very important factor in quality of performance on the Maze test. Similarly, correlations between quantitative and qualitative scores were low.

Using two methods to fix a critical score by which individual performance might be interpreted, Porteus found that 80 per cent of the delinquent boys had scores of 29 or above; the girls, 32 or above. A fair critical score for all groups was set at 39.

In summing up the results of his research, Porteus (1, p. 24) says:

> We may say that there is a marked tendency of delinquents as a group to carry out a simple task, such as drawing through a maze design, in an inexact, heedless, slipshod, or "nervous" manner, and to neglect instructions, especially when that task is incidental to the solution of a more immediate or overt problem. In a scoring system based on a weighting of slips and minor errors denoting poor quality of

execution, more than three times as many delinquents as normals earn total penalties above a critical score. The usefulness of the test for social prognosis depends upon the assumption that these modes of reaction are characteristic of the delinquent in his everyday behavior.

## B. Purpose

On the basis of Porteus' findings, it would seem that the Qualitative Maze Test can be used to measure those traits which are highly characteristic of the delinquent group. However, since Porteus' norms are based on scores made by subjects 14 years of age or older, the question arises as to whether these norms are valid for children below 14. It is conceivable that younger children will exercise less foresight than older subjects. If this is the case, obviously new norms will have to be established for the younger age groups. The present study is an attempt to evaluate the performances of younger children on the Qualitative Maze Test.

## C. Subjects

Fifty children at each of three grade levels were selected at random from the public schools of Jacksonville, Illinois. The first group consisted of eleventh graders, all of whom were 14 years of age or older, a second group consisted of eighth graders, and a third of children in the fifth grade. This provided children below 14 at two different age levels. It was hoped that any relationship between age and qualitative score might be brought out in these two groups. All groups were evenly divided as to sex. The subjects were, according to the principals and teachers, "normal children." No attempt was made to equate the groups for age, but there was a minimum of overlapping in age between grades.

## D. Procedure and Scoring

As in the Quantitative Maze Test, the subjects were tested individually. The original directions were given, with the revisions suggested by Porteus for use in the Qualitative test. It will be remembered that in the old directions, the subject was warned to keep his pencil on the paper; after the third warning, the test blank was removed, and a new trial given without penalty. In the new directions, only one warning is given. Although no penalties were attached, the subject was warned in the old test about crossing lines and cutting corners. In the new scoring, these count as errors.

The tests were scored both quantitatively and qualitatively. For the qualitative scoring, each error was recorded on a special form, and the number multiplied by the weighting for that particular error. To facilitate the

scoring for Lifted Pencil, where often no break is made in the line and it might easily be overlooked in later checking, the examiner noted on the back of each blank, the incidence of error. For example, when the pencil was lifted three times in one maze, the blank was marked *LP*-3. To prevent the subject from seeing these notations, the used blanks were kept out of sight. The only subjective scoring is concerned with Wavy Lines. In scoring this error, the examiner compared each performance with Porteus' photographs of penalized performances illustrating this error. In the present study, the examiner was assisted by three graduate students majoring in psychology. The tests were scored on the basis of these four ratings.

## E. Results

In order to provide some comparison with Porteus' results, the data obtained from the present study were tabulated according to his plan. Table 1 shows the incidence of qualitative errors in each group.

It will be noted that the total errors of the fifth graders are nearly twice as great as those of the eighth graders. The difference between the eighth and the eleventh graders is considerably smaller. There is little difference between boys and girls in total number of errors. This does not substantiate Porteus' findings about sex differences in the qualitative performance. He found that the performance of girls was, on the whole, somewhat inferior to that of boys, and concluded that this was probably due to sex differences in "temperament."

In considering the types of errors, it is found that the girls made more errors than the boys in Last Third, and in Lifted Pencil; the boys, on the other hand, made more errors in Cut Corners, Cross Lines, and Wavy Lines. The most significant difference in performance between fifth grade children and the two older groups occurred in Cross Lines, where the fifth graders scored more than twice as badly as did either the eighth or the eleventh graders. Except for Cut Corners, both fifth graders and eighth graders consistently scored more qualitative errors than eleventh graders. It is suggested that perhaps the older group traced more quickly, feeling more sure of themselves.

When qualitative errors are ranked according to incidence in the three groups, there is remarkable uniformity. In each group, Lifted Pencil occurs most frequently. With minor variations, next in order are First Third, Cross Lines, Wavy Lines, Last Third, Wrong Direction, Cut Corners, and Year VI. For the least frequent error, Year V, differences between grades are extremely small.

TABLE 1
INCIDENCE OF QUALITATIVE ERRORS

| Group | No. | First 3rd | Last 3rd | Cut corner | Cross lines | Lift pencil | Wavy lines | Wrong direc. | Yr. V | Yr. VI | Total errors |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5th grade boys | 25 | 73 | 26 | 27 | 75 | 164 | 67 | 33 | 4 | 12 | 480 |
| 5th grade girls | 25 | 81 | 35 | 10 | 45 | 181 | 45 | 21 | 8 | 17 | 444 |
| 5th grade total | 50 | 154 | 61 | 37 | 120 | 345 | 112 | 54 | 12 | 29 | 924 |
| 8th grade boys | 25 | 30 | 15 | 7 | 31 | 103 | 51 | 14 | 7 | 9 | 267 |
| 8th grade girls | 25 | 47 | 27 | 2 | 27 | 122 | 25 | 16 | 3 | 9 | 278 |
| 8th grade total | 50 | 77 | 42 | 9 | 58 | 225 | 76 | 30 | 10 | 18 | 545 |
| 11th grade boys | 25 | 26 | 14 | 5 | 32 | 98 | 55 | 6 | 6 | 4 | 246 |
| 11th grade girls | 25 | 26 | 19 | 11 | 21 | 93 | 36 | 15 | 3 | 8 | 232 |
| 11th grade total | 50 | 52 | 33 | 16 | 53 | 191 | 91 | 21 | 9 | 12 | 478 |

In comparing these results with those of Porteus' normal adolescents, we see that in incidence of errors, his group ranks about midway between our fifth and eighth graders. It might be expected that his subjects would compare most favorably with our eleventh graders, since these two groups fall within the same age range. However, Porteus' subjects made 10 times as many errors as did our eleventh graders in Cut Corners, and three times as many in Cross Lines. Our eleventh graders exceed Porteus' group in First Third, Lifted Pencil, and Wavy Lines. In Porteus' normal group, the most frequent errors are Cross Lines and Cut Corners; the most infrequent, Year VI and Year V. It will be remembered that the incidence of these latter errors was also low for the subjects in the present study.

Table 2 shows the weighted scores of the fifth, eighth, and eleventh grade children. There is a consistently higher difference between the average scores of the fifth and eighth graders than between the eighth and eleventh

TABLE 2

WEIGHTED ERROR SCORES OF FIFTH, EIGHTH, AND ELEVENTH GRADERS

| Group | No. | Average score | $SD_{dist.}$ |
|---|---|---|---|
| 5th grade boys | 25 | 40.84 | 19.35 |
| 8th grade boys | 25 | 22.92 | 11.34 |
| 11th grade boys | 25 | 22.2 | 14.91 |
| 5th grade girls | 25 | 35.12 | 19.75 |
| 8th grade girls | 25 | 24.8 | 18.15 |
| 11th grade girls | 25 | 19.88 | 14.08 |
| 5th grade total | 50 | 37.98 | 19.75 |
| 8th grade total | 50 | 23.86 | 15.3 |
| 11th grade total | 50 | 21.04 | 14.68 |

TABLE 3

DIFFERENCES BETWEEN AVERAGES OF WEIGHTED QUALITATIVE SCORES OF FIFTH, EIGHTH AND ELEVENTH GRADERS

| Group | Diff. bt. averages | Critical ratio |
|---|---|---|
| 5th and 8th grade boys | 17.92 | 3.96 |
| 5th and 11th grade boys | 18.64 | 3.7 |
| 8th and 11th grade boys | .72 | .14 |
| 5th and 8th grade girls | 10.32 | 2.23 |
| 5th and 11th grade girls | 15.24 | 3.76 |
| 8th and 11th grade girls | 4.92 | .94 |
| 5th and 8th grade total | 14.12 | 4.5 |
| 5th and 11th grade total | 16.94 | 5.52 |
| 8th and 11th grade total | 2.82 | 1.1 |

graders. The difference between the eighth and the eleventh graders is very small.

Table 3 presents the differences between the averages of the weighted qualitative scores of the three groups. Here the pattern noted in Table 2 is repeated. Great differences are apparent between the scores of the fifth and the eleventh graders, but an almost negligible difference between the scores of the eighth and the eleventh graders. That these differences are reliable is shown by the critical ratios. In each instance, the differences between the fifth and eighth graders and between the fifth and eleventh graders are statistically reliable. The smallest ratio, that for fifth grade girls and eighth grade girls, gives 98.6 chances in 100 that the difference is reliable. On the other hand, the differences between the eighth and eleventh graders are consistently unreliable. Chances range from 56 to 86 in 100 that these differences are greater than zero.

Further proof of the reliability of our data is furnished by a study of the level of intelligence of the subjects tested. Quantitative scoring of the Maze Test yields a Test Quotient which is roughly comparable to the Binet *IQ* (2). The average *TQ* for fifth graders was 111.62, for eighth graders 110.86, and for eleventh graders 101.88. This would seem to indicate that the younger subjects had a slightly higher level of intelligence than did the older group. Actually, however, the highest possible *TQ* for older subjects is 121, while younger subjects could score as high as 170. With this correction, it is apparent that the groups are fairly equally matched as to intelligence—the average score closely resembles the average score attained by the general population.

## F. Discussion

The unusually high incidence of Lifted Pencil in our subjects suggests that some explanation is due. The examiner noted that because the warning about lifting the pencil comes at the end of the directions for Year V, almost as an after-thought, many subjects were already looking over the maze and disregarded the warning. It may be said that those subjects were too impulsive or too impatient to wait for the final instructions. It might be possible, however, to make the warning more pointed by covering the maze until the complete directions are given, or by giving the warning elsewhere in the directions.

The fact that our subjects received many more penalties for Lifted Pencil than did Porteus' subjects may be due to the stricter scoring. It will be remembered that in the present study the examiner noted, during the test,

each time the pencil was lifted. Although Porteus suggests that this error be scored at the end of the examination by noting breaks in the line, we discovered that frequently when the pencil was lifted, no such break was apparent in the line. It is possible, then, that our scoring method may have caught more errors than did the one used by Porteus.

It was observed that left-handed children seemed to have an advantage in the earlier mazes; because the exit was at the right of the first six mazes, the sinistral subject could "keep an eye" on the goal throughout, while the right-handed subject had to lift his arm, and sometimes his pencil, to see it. This might be an interesting problem for further research.

The question of the relationship between age and qualitative score opens many new research areas. It might be possible, for example, to determine whether the high qualitative score of younger children is related to their relatively poorer motor coördination. Several of the qualitative errors might be traced to the child's inability to control the movements of his hand or pencil adequately. A study might be made of the correlation between children's performance in tests of fine motor coördination and their scores for these particular errors.

The most obvious problem is a more comprehensive study of the qualitative performances of children from four to 14 on the Maze Tests. In the present study, the differences in performance between our fifth and eighth graders are a good indication of the possibility that the differences in performance between the lower age and grade groups are large enough to be significant. After the eighth grade, the differences are not so sharply defined. Thus, norms could be established for each age, and tables constructed which would interpret a qualitative score in terms of the age of the subject. Whether the differences would be so great as to enable one to construct a scale which would discriminate in intervals of months, as well as years, is uncertain.

## G. Summary and Conclusions

The Porteus Qualitative Maze Test was administered to children in the fifth, eighth, and eleventh grades of the public schools of Jacksonville, Illinois. There were 50 children in each group, divided equally as to sex. The results of this study may be summarized as follows:

1. There is a definite relationship between age or grade and qualitative score.

2. There are greater differences between the performances of the fifth

and eighth graders than between the eighth and eleventh graders. These differences are statistically reliable.

3. When types of errors are ranked according to incidence, the three groups are discovered to have almost identical patterning. Although the number of errors varies, the order of incidence for each type of error is approximately the same in each group. Lifted Pencil was uniformly high, and Year V uniformly low.

4. Sex differences in performance are slight. The girls scored fewer errors in Cut Corners, Cross Lines, and Wavy Lines; the boys in First Third, Last Third, and Lifted Pencil.

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*105 Pleasant Street*
*Concord, New Hampshire*

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# SEX DISTRIBUTION OF INTELLIGENCE AMONG INFERIOR AND SUPERIOR CHILDREN*

*Murray State Teachers College, Murray, Kentucky*

W. DRAYTON LEWIS

The early studies of the distribution of intelligence among school children appeared to indicate that a greater number of boys were to be found both at the upper levels of intelligence and at the lower levels. The writer is not aware of any experimental finddings that do not support the view that more boys are to be expected at the lower levels of intelligence, but it is of interest to note that more recent findings do not substantiate the earlier findings that more boys than girls are to be expected among superior children. This is particularly true at the elementary school level where intelligence tests have proved to be most valid.

The findings of the early studies of gifted children were such that Terman and Burks were led to conclude, in a summary of the literature relative to gifted children in 1933 (16), that more boys than girls are almost invariably found among gifted children. They concluded that the disparity increases with age, that whereas the proportion is about seven boys to six girls at the elementary school level, a proportion of two boys to one girl may be expected at the secondary school level. They cited Yates' findings of a ratio of 150:100 in 1922, Book's of 200:100 in the same year, Colvin and McPhail's of 190:100 in 1924, and Terman's of 212:100 in 1925.

Conklin (4) reported finding 93 superior boys to 25 superior girls in a Brooklyn high school where the sexes were evenly divided, which is a ratio of only slightly less than four to one. Blair (1), in a study reported in 1938, found no such disparity among high school students in Everett, Washington, although he also found more boys than girls in the superior group. He found 127 superior boys to 95 superior girls in the senior high school, and 120 girls to 104 boys in the junior high school, using an Otis test as a measuring instrument.

Witty (18) has reported the results of extensive testing of children distributed through grades nine to twelve in 13 secondary schools. These findings are at variance with those cited by Terman and Burke. The testing instruments used include the Terman group test, the Otis S.A., Henman-

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Nelson, Illinois, Army-Alpha, and a few miscellaneous tests. Ninety per cent of the children were tested with either the Terman or Otis test. The tested population included 14,149 boys and 13,493 girls. The summary of test results discloses that almost identical numbers of boys and girls attained intelligence quotients of 140 or above, and that there was practically an equal sex distribution in the interval 130 to 139. The 75th, the 90th, and the 99th percentile scores were the same for boys and girls. Witty concluded, on the basis of his findings, that the boys and girls enrolled in the high schools studied were of decidedly similar intelligence as measured by the intelligence tests used and that the ratio of gifted boys to gifted girls is not two to one, as reported by Terman and Burks, but more nearly one to one.

The writer has assembled data which appear to provide further evidence that some selective factor or factors favoring the boys were operating in the early studies of superior children. It would appear at the present time that these early reports do not provide a true picture of the actual sex distribution of superior ability. The writer is unable to point out what the selective factor, or factors, were but it does seem evident, now, that we are no longer justified in concluding that a greater number of boys than girls may be expected to attain high scores on intelligence tests at the elementary school level. The purpose of this study is to present evidence in substantiation of this conclusion for children in grades four to eight.

Terman and Burks (16), as has been noted above, concluded that there are more superior boys than girls at the elementary school level by a ratio of seven to six. Jones (8), reporting a study of 120 superior children with intelligence quotients over 140 and ranging in ages from three years and eleven months to fourteen years and nine months, with a mean chronological age of nine years and nine months, shows a sex distribution of 57.5 per cent boys and 42.5 per cent girls. The number of boys and girls examined was reported to be approximately the same and selection was based on a battery of tests.

Pressey (12) tested 2544 school children in an early investigation. He found that at the upper levels of intelligence there were larger numbers of boys than of girls. The distribution was 66 per cent boys and 34 per cent girls in the highest three percentiles.

Other studies which have been reported do not bear out these findings. Witty (18), in a study of superior elementary school pupils in the schools of Kansas City, Missouri, and a number of Kansas towns, found that the ratio of boys to girls among pupils having intelligence quotients above 140

was 104:100, which was in the same proportion as the school population. The measuring instruments used by Witty in making these selections were the same as those used by Terman in his earlier study in California, the National test and the Stanford-Binet scale. There is no obvious reason for differences in the findings.

A very recent summary which is highly pertinent to the matter under discussion is found in the last publication of Mrs. Hollingworth (7). She gives a summary of the children reported to test over 180 *IQ*. Nineteen cases have been reported by others, 12 girls and 7 boys. She found 12 cases, eight boys and four girls. It is interesting to note the male bias which prevails throughout her studies of gifted children. The grand total of cases with *IQ* of 180 or more which she reviews is 31, 16 girls and 15 boys. This would appear to indicate a uniform sex distribution among very superior children.

The conclusion which has been generally accepted is that boys are more variable, that a greater number of boys are to be found at the lower levels of intelligence as well as at the upper levels. Findings appear to substantiate the conclusion that more boys are to be found at the lower levels of intelligence. Much of the literature states unequivocally that boys predominate at both extremes. The writer is questioning the conclusion that they predominate at the upper levels although he is inclined to accept the conclusion that the boys predominate at the lower levels of intelligence, at least during elementary school ages.

Witty reported that his study revealed a consistent difference in favor of the girls at the lower levels of intelligence, but found the differences too small to be of much significance. Pressey (12), reporting one of the earliest investigations, a study in which 2544 school childrden were tested, found that 61 per cent of the lowest 10 per cent were boys.

St. John (12) concluded, after having administered a number of intelligence tests to 503 boys and 455 girls in the elementary schools of Boston, that boys are slightly more variable than girls in intelligence though he found no significant differences in the average intelligence quotient. McGehee (11) reworked some of St. John's data and found that, whereas the ratio of boys to girls in his study was 110:100, the ratio of boys to girls, where the intelligence quotients are below 90, is 138:100 and that the sex ratio of those with intelligence quotients below 80 is approximately 244:100.

The writer undertook the present investigation as a result of his study of gifted children (10). Coördinated Studies in Education, Incorporated, surveyed some 45,000 elementary school children in 455 schools and 310 communities in 36 states. The children studied in this investigation were in

grades four to eight, inclusive, and the measuring instrument was the Kuhlman-Anderson Test. A detailed study of the upper 10 per cent was made by the writer. Four thousand five hundred and twenty-nine children were included in this upper 10 per cent, of whom 2676 were girls and 1853 were boys. There were 549 girls and 375 boys in the upper 2 per cent, a total of 924, which gives a ratio of 146.3 girls to 100 boys. This finding is clearly at variance with previous studies and suggests that the last word on the sex distribution of superior children has not been spoken.

McGehee (11) made an extensive study of the lower 10 per cent and found the opposite type of distribution. Four thousand six hundred and twenty-seven children were in this group, of whom 3009 were boys and 1618 were girls. This finding is in accord with those of former studies.

The data summarized in Table 1 shows that on the test used in this survey, the Kuhlmann-Anderson Test, the girls predominate at the higher levels, whereas the boys predominate at the lower levels. Median mental ages, as given in Table 2, are higher for the girls at each grade level. Median chronological ages, as given in Table 3, reveal that the girls are slightly younger, which indicates that the data in Tables 1 and 2 slightly under-

TABLE 1

A Sampling of the Distribution of *IQ*'s, on the Kuhlmann-Anderson Test, of Unselected Children in Grades IV-VIII, Inclusive, Giving the Division of Boys and Girls in Each Interval by Numbers and Percentages

| *IQ* level | Distribution of *IQ*'s | | Per cent in each *IQ* Group | |
|---|---|---|---|---|
| | *Boys* | *Girls* | *Boys* | *Girls* |
| 120 Up | 267 | 326 | 38.8 | 61.2 |
| 115-119 | 281 | 370 | 43.8 | 56.8 |
| 110-114 | 472 | 647 | 42.2 | 57.8 |
| 105-109 | 613 | 708 | 46.5 | 53.5 |
| 100-104 | 711 | 713 | 50.0 | 50.0 |
| 95-99 | 701 | 592 | 54.2 | 45.8 |
| 90-94 | 669 | 448 | 59.8 | 40.2 |
| 80-89 | 793 | 495 | 61.5 | 38.5 |
| 70-79 | 278 | 144 | 66.0 | 34.0 |
| Below 70 | 82 | 24 | 77.4 | 22.6 |
| Number of cases | 4807 | 4467 | 51.8 | 48.2 |

TABLE 2

A Comparison of the Median Mental Ages of Unselected Children By Grade and Sex

| | Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 |
|---|---|---|---|---|---|
| Boys | 9.80 | 10.60 | 11.73 | 12.73 | 13.15 |
| Girls | 10.01 | 10.78 | 11.88 | 13.02 | 13.55 |

TABLE 3
A COMPARISON OF THE MEDIAN CHRONOLOGICAL AGES OF UNSELECTED CHILDREN, BY GRADE AND SEX

| | Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 |
|---|---|---|---|---|---|
| Boys | 9.73 | 10.78 | 11.76 | 12.75 | 13.74 |
| Girls | 9.50 | 10.58 | 11.53 | 12.68 | 13.58 |

estimates the mental superiority of girls at these age levels, at least as far as mental ability is measured by the Kuhlmann-Anderson Test. There is no evidence here to support the view that more boys are found at both the lower and higher levels of intelligence. The shift from male dominance at the lower levels to female dominance at the higher levels is consistent, with an even distribution at approximately the 100 level.

A comparatively recent study, one by Riggs (13), largely substantiates these findings even though a different measuring instrument was used. Riggs administered the National Intelligence Test to 10,079 children in grades three to eight of 22 city schools. Parenthetically, it is of interest to note that this measuring device is one of the instruments used by Terman and by Witty in their investigations. The mean intelligence quotient of the girls was found by Riggs to be 3.4 points higher than that attained by the boys and, as in the data investigated by the writer, there is no evidence to support the view that more boys are to be found at both extremes of the distribution of intelligence. The writer has reworked some of Riggs' data and finds that the sex distribution in the upper 7 per cent is 100 boys to 132 girls, whereas in the lower 7 per cent the production is 100 girls to 147 boys. Riggs concluded that boys are only slightly more variable than girls in intelligence at the elementary school level in so far as intelligence is measured by the National Intelligence Test.

Conclusions relative to sex distribution of intelligence are exceedingly hazardous since perfect measuring instruments are not available. Intelligence tests vary in composition and studies have shown that some types of test items favor boys whereas others favor girls. This means that the question regarding the relative variability of girls and boys in intelligence is at least partially answered when the items which are to compose the test are selected. There are a number of possible positions here. It has been shown repeatedly that a predominance of linguistic items favors girls whereas a predominance of items dealing with number concepts and arithmetical abilities, including computation and arithmetical reasoning, favor the boys.

Freeman (5) has pointed out that the linguistic ability of the female may be *both* a cause and a symptom of mental superiority on the part of the

female, provided, of course, that linguistic ability develops more rapidly in the female than the male, as it appears to do. He believes that this linguistic superiority of the girls, which he accepts as a fact, is evidence of real mental superiority. The fact that intelligence tests are definitely biased linguistically would not be accepted as invalidating them, if this view were accepted, and the evident superiority of girls on such tests would be accepted as a real superiority.

Terman and Merrill (17), on the other hand, appear to have taken the position that sex differences in intelligence are not real. They report that sex differences found in their standardization of the Binet tests for the recent Terman-Merrill revision were of relatively small magnitude. Trial batteries which yielded the largest sex difference were eliminated as probably unfair. The percentage passing each test item was determined for both sexes as a basis for eliminating tests which were relatively less "fair" to one sex than the other. The writer recognizes that this might be done so that approximately identical medians were obtained for the two sexes and yet one sex might prove to be more variable even when test items were selected as Terman and Merrill did. The point here is merely that some viewpoint must be taken relative to sex differences when the items to be included in the intelligence test are selected.

Test constructors may point out in favor of such a procedure that median scores for boys and girls on intelligence tests do not differ significantly. It remains true that if a test has a definite linguistic bias, as for example, Pressey's or the Kuhlmann-Anderson, girls appear to be slightly more intelligent. The writer has found no criterion for determining what balance should be maintained between linguistic material and mathematical concepts.

Evidently, those constructing intelligence tests face a dilemma, the question to which they seek an answer, "Are there sex differences in intelligence?", must be answered in advance, in part at least, since some position must be taken relative to the question in the selection of the test items which are to make up the intelligence test.

It has long been recognized that some intelligence tests favor one sex, some the other. The Army Alpha favors the male sex, probably due to the fact that it was standardized on men. The Pressey Test and the National Intelligence Test favor girls (9). It is evident that the Kuhlmann-Anderson Test, with its linguistic bias, favors the female sex. The whole matter appears to go much deeper than merely that of determining sex differences as revealed by the various intelligence tests which are available. The fundamental issue is that of the nature of intelligence and there is no general

agreement on that question at the present time. Those constructing intelligence tests have tried to avoid this fundamental dilemma through an empirical approach, that is, test items are selected on the basis of children's reactions. The basic assumption is that intelligence grows continuously and, therefore, if children of each succeeding age group do better on a given test item it must be assumed to be a good test of intelligence.

Conclusions relative to sex variability in intelligence must be based on intelligence tests, and measuring instruments are not available that will permit one to go further in his conclusions than that the various intelligence tests give various answers relative to sex variability in intelligence. The writer does believe, however, that there is no longer any justification for stating that more superior boys than girls are to be expected. It seems evident that in cases where large, unselected elementary school populations have been surveyed with intelligence tests that a predominance of boys at the upper levels has not appeared. It must be recognized, relative to the data presented in this study, that an intelligence test with a definite linguistic bias was used, namely, the Kuhlmann-Anderson Test, so that the larger numbers of girls in the upper level may be, in part, an artifact of the test. The same may be said of Riggs' study which used the National Intelligence Test, a test which also favors the female sex.* This female superiority would have to be accepted as real, however, if Freeman's view that the linguistic superiority of the girls is an evidence of real mental superiority.

The female superiority as revealed in this study does not necessarily indicate an inherent superiority of girls over boys in intelligence. Several factors may well account for part, if not all of the difference. It is recognized that boys do not develop as rapidly as girls, the retardation possibly being as great as a year or a year and a half. This would place more girls at the higher levels and more boys at the lower levels during the elementary school period. It is possible that this is the major factor in the difference. Most intelligence tests weight linguistic ability rather heavily and to this extent favor girls rather than boys. Intelligence tests are also to some degree achievement tests and to the extent that they are achievement tests are apt to favor girls rather than boys. Boynton (2) has pointed out that this is particularly true of the National Intelligence Test. The writer is unable to account for the predominance of boys in the early studies of gifted children, particularly in view of the fact that the same measuring instruments, when used as the basic method of selection with large groups of unselected children, have not indicated a predominance of boys at the higher level. It is worthy of notice, though, that the superior children included in the

early groups studied were not selected on the basis of comprehensive testing programs, as was true in the later studies. The tests in the Terman study were administered to children who had already been brought to the attention of those conducting the study by teachers and others interested in the particular child. Perhaps, the selective factor involved entered at that point.

No generalizations from findings at the elementary school age are justified relative to the secondary school or adolescent age. Findings at the adolescent level are more open to question because the intelligence tests are less valid at that age. A basic assumption of intelligence testing is a community of experience for those tested, and such an assumption is less valid at the secondary school level than it is in earlier years since, obviously, with the passing years a diversity of experience is more and more prevalent. It is generally held that boys tend to "catch up" with girls during early adolescence, and, if that is the case, we would expect the superiority of the girls to disappear gradually. Some hold that the boys eventually surpass the girls, and, if that is true, then boys may come to predominate at the upper levels of intelligence. Our measuring instrument, the intelligence test, does not appear to be sufficiently valid at this level to justify conclusions at the present time.

The writer believes that the information at hand indicates that we may expect to find, at the elementary school level, a greater number of girls in the superior group and a greater number of boys in the inferior group. Whether this represents an actual superiority on the part of the girls, or is simply an evidence of the slower development of the boys, is not yet clearly evident. The writer is inclined to believe that it is probably largely a result of the slower development of the boys.

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*Murray State Teachers College*
*Murray, Kentucky*

# SHORT ARTICLES AND NOTES

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## TONE COLOR DISCRIMINATION OF GRADE VII BOYS*

*Department of Psychology, Maritime Academy of Music, Halifax, Canada*

CYRIL C. O'BRIEN

Can the ability to discriminate tone colors be improved with practice or is it a trait latent in the individual and accordingly a capacity? In the investigation "tone color discrimination" was used synonymously with "quality discrimination."

Quality discrimination, as is generally interpreted, means the talent or ability to distinguish one kind of sound from another. The majority of people have sufficient aural power to differentiate between the sound of a piano and the human voice. To discriminate between a flute and a clarinet requires a keener competency for noting tone color, while to observe by sound the difference between a violin and a viola would necessitate a further refined sense of tone quality. The comparison can be carried to the extent of a very fine dividing line between two shades of tone. In this instance, synthetic sounds very similar in quality design, may be produced by the technique of the acoustical laboratory.

The present experiment was undertaken to discover whether quality discrimination as measured by the Kwalwasser-Dykema Test was an aptitude, or whether it was acquired and improved with practice. The experiment was performed with two Grade VII classes of boys, Grade VII-*A* and Grade VII-*B*, in Halifax, N.S.

Grade VII-*A* was the experimental class, receiving special training in discriminating tone colors for three consecutive months. Grade VII-*B* was the control class and received no help or instructions of this nature during the three months period.

There were 31 boys in Class *A* and 35 in Class *B*. On the first day of the experiment, both classes were given the Quality Discrimination Test by Kwalwasser-Dykeman. In this particular Test the subject is requested to state whether two successive two-tone patterns are played by the same or different instruments. The response required is to print "*S*" for Same or "*D*" for Different. The Test measures the competency to detect whether the

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quality is produced by the same orchestral instrument or different orchestral instruments. The pitch of the motive played by the paired instruments is always the same in the Test, so when there is a difference, it is one of tone color.

The Test, consisting of 30 trials, was given to the two classes as stated. The following table indicates the means, medians, and standard deviations obtained as results, using the raw scores from the first testing of the two groups (Table 1).

TABLE 1

| | No. in Group | Mean | Median | *SD* |
|---|---|---|---|---|
| Class *A* | 31 | 22.09 | 23 | 2.56 |
| Class *B* | 35 | 22.57 | 23 | 1.93 |

During the three months following the first testing, the experimental class was given practice in most possible ways upon the recognition of quality. All the principal instruments of the symphony orchestra were taught by name and sound. They were heard not only singly but also in combinations of two's, three's, four's, five's and larger numbers. Phonograph records featuring large groups of orchestral instruments of 30 or more were used to present the factor of tone color to the pupils. Class *A* was furnished with a continual variety of sound from 50 double-sided recordings by the Victor Company. The chief instruments of the symphony orchestra which were heard and compared by the students are listed in Table 2.

TABLE 2

| Strings | Woodwinds | Brasswind | Percussion |
|---|---|---|---|
| Violin | Piccolo | French Horn | Snare Drum |
| Viola | Flute | Trumpet | Bass Drum |
| Violoncello | Oboe | Cornet | Tympani |
| Contrabass | English Horn | Trombone | Cymbals |
| Harp | Clarinet | Bass Trombone | Gong |
| | Bass Clarinet | Tuba | Triangle |
| | Bassoon | | Tom-Tom |
| | Contra Bassoon | | Castanets |
| | | | Tambourines |
| | | | Chimes |
| | | | Xylophone |
| | | | Orchestra Bells |
| | | | Celeste |

The sounds of the above instruments were heard for 60 school days, the sounds being rendered both singly and in ensemble. Nine hundred and ninety-two different combinations of these instruments were played during

this time. In addition, the pupils of Class *A* were encouraged to listen to soli and orchestral groups on the radio every evening. While no precise data on the exact time spent and ensembles heard was obtained for this part of the experiment, there was every reason to believe that the majority of the pupils were interested and followed frequently instrumental programmes over the radio at home. At school, the experimental class received drill on the individual items comprising the *K-D* Quality Discrimination during the three-month period. An average of one-half hour each day, Saturday and Sunday excepted, was utilized trying to improve quality discrimination.

After the subjects became familiar with the general recognition of instruments in groups of two's, three's, etc., they heard renditions by large orchestras for the purpose of identifying individual instruments. At the end of three months' intensive training, Grade VII-*A* was again tested together with Grade VII-*B* which had received no musical training except elementary theory of music during the three-months period. Tables 3 and 4 show a summary of results.

TABLE 3

| Class *A* | No. in group | Mean | *SD* | Median |
|---|---|---|---|---|
| First testing | 31 | 22.09 | 2.56 | 23 |
| Second testing | 31 | 23.00 | 2.91 | 23 |

TABLE 4

| Class *B* | No. in group | Mean | *SD* | Median |
|---|---|---|---|---|
| First testing | 35 | 22.57 | 1.93 | 23 |
| Second testing | 35 | 23.51 | 2.00 | 24 |

According to most psychologists in music, the basic capacities comprising musical talent are not conditioned by age, and children are not inferior to older people in their discriminating perception of differences. In fact, it is believed that age is neither a help nor a hindrance. Adults naturally have greater power of application, better attention, and a clearer understanding of the test instructions.

Again, many of the latent capacities of musical talent do not vary with sex to any significant degree. Accepting the findings of the most recent research, musical talent is not sex-linked. In cases where girls have had considerable more training than boys, the records show no appreciable difference in favor of the girls.

Assuming that the two previous paragraphs apply also to the trait of quality discrimination, from an investigation of the frequency curves representing the data tabulated above, it would appear that power to detect tone colors, as measured by the *K-D* Quality Discrimination Test, is a capacity—and latent to the extent that it cannot be improved with practice.

*166 North Street*
*Halifax, N. S., Canada*

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# SOME COMPARISONS OF NEGRO AND WHITE DELINQUENT BOYS*

*Children's Court, New York City, and Eastern Washington College of Education, Cheney, Washington*

CLAIRETTE P. ARMSTRONG AND FLORENCE HEISLER

The purpose of this investigation is to ascertain whether there are differences between Negro and white delinquent boys in intelligence and mechanical aptitude, also in arithmetic and reading achievement.

Evaluation of group abilities which after all summarize individual differences, is important as a basis for an adequate school program. It is propaedeutic not only for a normal school adjustment but also for a normal social adaptation that the school curriculum should be gauged to children's abilities. Obviously there should be a common meeting ground. Education should be within a child's grasp. However, it is possible that pupils subjected to the current school system may have little in common with its fundamental educational principles,—indeed may be poles apart. Thus maladjustments often leading to delinquency may arise.

The subjects of this research are native-born delinquents arraigned on various charges in the Children's Court, New York City, from 1938 to 1940, numbering 100 white boys 14 years old and 100 age 15, who are compared with 100 Negro boys of 14 and 100 of 15 years. A boy was included in this study when he happened to have had besides the Stanford-Binet Test, (more generally the 1916 revision than the 1937) both the Woody-McCall Mixed Fundamentals (arithmetic), and the Stenquist Test of Mechanical ability, Series I. Fewer of these boys had had the Monroe Silent Reading Test,—147 whites who are compared with 115 colored in reading comprehension.

Table 1 shows that the 200 Negroes 14 and 15 years old had an average chronological age 14 years 11.7 months, the whites 14 years 11.3 months, about two-fifths of a month younger than the Negroes. The few days seniority of the Negroes is statistically negligible, but did it count for aught, it would favor them on test scores.

The Stanford-Binet mental age of the colored boys, 11 years 9.95 months, was statistically inferior to that of the white boys, 12 years 6 months. Of

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TABLE 1

GROUP COMPARISONS

| Number | White 200 | Negro 200 | Diff. | Sigma diff. | $\frac{D}{\text{Sigma diff.}}$ |
|---|---|---|---|---|---|
| Birth Age | 14 yrs. 11.26 mos. | 14 yrs. 11.69 mos. | .435 mos. | .696 | .625 |
| Stanford-Binet Mental Age | 12 yrs. 6.26 mos. | 11 yrs. 9.95 mos. | 7.8 mos. | 2.15 | 4.33 |
| Woody-McCall Arithmetic | | | | | |
| Age " | 10 yrs. 8.4 mos. | 9 yrs. 7.89 mos | 12.66 mos. | 2.102 | 6.02 |
| Grade " | 5.863 | 4.981 | .944 | .1606 | 5.807 |
| Stenquist | | | | | |
| Equalled or exceeded by | 33.275% of norm | 39.55% of norm | 6.275 | 2.598 | 2.41 |
| Average or over | 152 or 76% | 134 or 67% | | | |
| Below average | 48 or 24% | 66 or 33% | | | |
| Monroe Reading Test | | | | | |
| Number | 147 | 115 | | | |
| Reading comprehension | 5.279 grade | 4.809 grade | .470 | 1.4765 | .3184 |

the Negroes 61 or 30.5 per cent had a mental age 12½ years or better and 139 or 69.5 per cent were below 12½ years. Of the whites 97 or 48 per cent had a mental age 12½ years or better, and 103 or 51.5 per cent were below. Only 25 or 12.5 per cent of the colored boys had a mental age 12¾ years or better, and 97 or 48 per cent were below 11¼ years. Only 50 or a fourth of the whites had a mental age 12¾ years or better, and 63 or 31.5 per cent were below 11¼ years. While both groups averaged below normal in intelligence, the average *IQ* of the whites being 83, of the Negroes 79 (using 15 years as adult age on the 1916 revision), there were more Negroes of very inferior intelligence than whites.

On the Stenquist Test the Negroes were equalled or exceeded by 39.55 per cent of the boys of 15 years on whom the test was standardized, the whites by 33.28 per cent. The small superiority of the whites over the Negroes is not statistically reliable. Average or better mechanically were 134 or 67 per cent of the Negroes and 152 or 76 per cent of the whites.

On the Woody-McCall Arithmetic Test the colored had an arithmetic age 9 years 7.9 months, the whites 10 years 8 months, a statistically reliable inferiority of the Negroes. The latter averaged arithmetically grade 4.9, approximately the 5th grade, the whites grade 5.9, approximately the 6th grade. Lack of ability to figure was general.

On the Monroe Silent Reading Test, comprehension of the colored was nearly 5th grade, 4.8, and the whites were slightly along in the 5th grade, 5.28. The former were not statistically reliably worse than the whites. Lack of understanding of simple prose was prevalent. Yet the group averages are somewhat high since some non-readers were excluded. Others were omitted for lack of time.

The difference between the Negroes and whites in intelligence and scholastic skills is purely academic for most of both groups cannot keep up with children of the same age in school. However, the arithmetic and reading disabilities are greater than the intelligence levels, however meagre, would warrant. Both colored and white boys are probably innately capable of somewhat better achievement.

Thus arises the question how far could this situation be improved by highly specialized instruction? For example, would a return to some of the old-fashioned pedagogical ideas such as teaching the alphabet, help, since many of these boys do not know their letters, and cannot distinguish between *t* and *l*, etc., in reading or writing? The laws of learning would seem to substantiate an affirmative answer. That the colored boys are more in need

of a different method of instruction than the white, has been shown by this study; however, all of these children might be improved thereby.

That many children are ineducable even with every possible aid, by the standards set today, should be recognized and admitted. Children would be happier and delinquency lessened were the goal of education training in accordance with abilities. If delinquents generally are so often good mechanically as these New York groups, despite the possibility of their scores on a test standardized nearly a quarter of a century ago being somewhat high in view of the prevalent mechanical progress, the need for more wide-spread manual training and shop work in school is evident. The ranks of maladjusted and antagonistic boys would be undoubtedly depleted by training early according to aptitude, thus substituting success for failure and thereby lessening emotional disturbances. Although mechanical ability minus innate intelligence and capacity to read and figure, may not carry a boy far in a trade, he could still be taught some job selected from a variety of tasks in well-equipped trade schools, at which he could succeed if only under supervision.

In summary, these 200 New York City delinquent colored boys averaging about 15 years like the 200 whites, were even below the retarded whites in intelligence and arithmetic, and but slightly so in reading. Both groups were above average mechanically, the whites but little more so than the Negroes. This points to the advisability of a revised teaching program and subject content, whereby better adjustments and indirectly, less delinquency may result.

*Psychiatric Clinic*
*Domestic Relations Court*
*137 East 22 Street*
*New York City*

*Eastern Washington College of Education*
*Cheney, Washington*

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# HYPNOTISM IN THE CLASSROOM*[1]

*Department of Psychology, Western College*

PETER J. HAMPTON

Within the last 10 years hypnotism has again come into the field of active research. Much hope is held out for hypnotism as a therapeutic technique. It is suggested that hypnotism may be used to advantage in the treatment of schizophrenia, manic-depressive psychosis, paranoia, hysteria, kleptomania, anxiety neurosis (2), alcoholism (1), bad habits, speech defects, tuberculosis, drug addiction, criminal tendencies (3), and many other debilitating difficulties with which an individual may be afflicted.

No doubt the views on hypnotism as found in the current literature are too optimistic. Hypnotism is not the panacea for all ills. The optimism expressed does not, however, detract from the fact that hypnotism is no longer a field of human experience to be ignored by the instructor of general or abnormal psychology. Hypnotism stands in the same category as the physical or biological sciences. It rests on sound principles and is a phenomenon operating in accordance with basic laws of human nature. To ignore hypnotism therefore is folly. The instructor in psychology can no longer afford to shrug his shoulders at hypnotism. He has to tell his students about it. What is more, if he is to follow present trends in psychology, he will want to demonstrate hypnotism to the class.

This paper is concerned with showing how the various phenomena of hypnotism are demonstrated to students of general and abnormal psychology at Western College. The approach to hypnotism favored at Western College is by way of the unconscious mind. It is assumed that during the normal waking state the conscious mind is in control of the body. In the hypnotic state the conscious mind is dethroned by the prestige suggestions coming from the hypnotist. The subject's actions thus come under the will of the hypnotist who controls the subject's activities and deals directly with his unconscious mind.

The first step in the induction of hypnotism is thus an attempt by the hypnotist to control the unconscious mind of the subject. Succeeding in this, the subject will accept any suggestions that come from the hypnotist,

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provided, of course, these suggestions do not go counter to any of the subject's principles of belief.

Having thus unseated the conscious mind of the subject by means of prestige suggestions, the hypnotist is ready for the second step in the procedure. By himself the subject will remain as if in sleep and will do nothing. Consequently the hypnotist has to use a further course of suggestion to make the subject do his bidding. From here on let us follow the hypnotist as he goes through his actual demonstration of the various phenomena of childhood regression.

Since suggestion is his key, and relaxation makes the subject more open to suggestion, the hypnotist first of all seats his subjects in comfortable chairs —at Western College we use upholstered easy chairs with backs for the students to rest their heads when they go off into the trance. Then with the lights dimmed and a final admonition to the class to refrain from making any noise, the hypnotist, turning to his subjects, raises his right arm and begins his induction.

"I want you to look at the object I have in my hand,"—a round polished metal knob reflecting a good deal of light—he says. "Relax completely. Can you see this now? When you look at this object your eyes feel just a little strained. Soon your eyes are going to close and you are going off to sleep. Your arms and legs feel very heavy and tired. You are sinking into a deep sleep. Your eyes feel very heavy. You want to shut your eyes. Your eyes will close, close, close, close, close. You cannot keep your eyes open any longer. Your eyes are shut, shut, shut, shut. You are completely relaxed and you are going off to sleep, into a very comfortable sleep. You are going to sleep now until I count ten and say, 'All right.' You are going to sleep now until I count ten and say, 'All right.' You are going to sleep now until I count ten and say, 'All right.' You are going to sleep now until I count ten and say, 'All right.'"

"As I touch your wrist I want you to nod if you are asleep." The subjects, five of them, nod when touched and the hypnotist resumes his suggestions in a monotone drone. "You will not wake up until I count ten and say, 'All right.' You will not wake up until I count ten and say, 'All right.' You are in a very deep sleep. You are in a very deep sleep. You will not wake up until I count ten and say, 'All right.' You are in a very deep sleep. You will not wake up until I count ten and say, 'All right.'"

With the subjects all in a deep trance by now, the hypnotist is ready to begin his demonstration of childhood regression. He asks Mel Leckie, one of the subjects in trance, to stand up. Mel stands up. Turning to the

subjects who remain seated, the hypnotist repeats his incantations. "You are in a deep sleep and you will remain asleep until I count ten and say, 'All right.' You will remain asleep until I count ten and say, 'All right.' You will remain asleep until I count ten and say, 'All right.'"

Then turning to the student standing, the hypnotist begins to question her in a suggestive manner. "Mel, you are an actress, aren't you?" Affirmative reply. "When did you take part in your first play?" "When I was nine." The student's present age is 19. "What was the name of the play?" "Three Souls in a Pillbox." "What part did you have?" "Scrubwoman." "How many scenes were there?" "One, I think." "Now then, I want you to go through your entire part until I tell you to stop. Remain where you are. Begin."

"Hello, Tony, are you feeling better? Have you taken the pills, the green one and red one? You gave them away! Oh, Tony! You'll *never* get well! You gave one to me; who did you give the others to? The scissors grinder? Oh, Tony, I'm very sorry. It was so lovely to be the scrubwoman's soul again. It was so lovely being beautiful again. It was so lovely to go away. We're so far away, Tony! I hope you're feeling better."

At this point the demonstrator interrupts and says, "Stop." He continues with his questions. "Can you dance?" "Yes." "Can you jitterbug?" "Yes." "What do you like to jitterbug to—Johnson Rag?" Affirmative answer. Mel jitterbugs mildly. The demonstrator continues with his questioning. "Do you know 'Deep Purple?'" Affirmative answer. "Hum the music and dance." Mel hums and dances.

The demonstrator again interrupts with "Stop." He now leads the subject to her chair and seats her, saying, "You are fast asleep. You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.'" Then to the rest of the subjects in the hypnotic trance. "You are all in a very deep, deep sleep. You are in a comfortable sleep and you are going to remain asleep until I count ten and say, 'All right.'"

Continuing with his demonstration of childhood regression, the hypnotist now tries another subject. "Bessie, stand up," he says. Bessie complies. "You are fast asleep, Bessie. You are fast asleep. You are fast asleep. Now, Bessie, did you ever learn 'Old Ironsides' when you were in grammar school?" "No." "'The Night Before Christmas?'" "Some of it." "Which part?" "The first." "How old were you when you learned that?" "About

six." "Imagine you are six years old, Bessie, and your teacher has asked you to recite. Take a bow and recite." Bessie bows and recites it as far as "old Santa Claus soon will be there." "Did you learn any other poems when you were six years old?" "Yes, 'Beside the Sea.'" Bessie recites. All her speech is in a rather fretful, childlike voice. When she finishes the demonstrator says, "Thank you, Bessie."

He continues. "Did you ever have a part in a play?" "Yes, 'The Wedding of Jack and Jill.'" "What was your part?" "I was Jill." "All right, Bessie, you are four years old now. Go through your part." Bessie begins to recite. "Of course, you do, you goose—that's all I said." The demonstrator then seats Bessie, saying to all the subjects in hypnotic trance, "Relax, you are fast asleep. You are fast asleep. You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.'"

To show another phase of childhood regression, the demonstrator next has Anne Buford stand up. "I want you to imagine that you are four years old, Anne," he says. "Your mother tells you to go to the store." Anne says, "No," emphatically and crossly. "Why don't you want to go to the store?" "I want to play." "Who do you want to play with?" "Susie." "Who else do you want to play with?" "Tommy."

"Did you ever have a birthday party, Anne?" "Yes." "How old were you?" "Seven, maybe before that six." "Now let's go back to your sixth birthday party. I want you to tell me who was at the party." "Jane." "Jane who?" "Jane Lesser,—Susie,—Tommy." "What was Tommy's last name?" "Brooks." "What did you wear at your sixth birthday party?" "Blue." "Do you know what color of bow, or did you wear a bow?" "No."

"Now you are back here with us again. I want you to imagine that you're a little puppy dog up on all fours begging for food." Anne barked like a puppy dog several times, and the demonstrator said, "All right, here's the food," holding out his hand. "Put it in your mouth and eat it." Anne puts her hand to her mouth and begins to chew. The demonstrator then leads Anne back to her chair and she sits down. And again the hypnotist repeats his incantations. "You are all fast asleep. You are in a very, very deep sleep. You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.'"

The demonstration of childhood regression goes on. The hypnotist asks Margie Dilatush to stand up. He leads her to a piano and seats her on the piano stool. "Now, Margie," he says, "you played the piano when

you were young. How old were you when you learned to play?" "Four." "Imagine you are four years old, Margie. Let's hear what you can play. What can you play?" "Frere Jacque." Margie plays the melody very slowly with one finger of her right hand. Then the demonstrator says, "Now you are eight years old. What can you play?" "March of the Sleepy Heads." She begins to play then says, "I can't remember it," but goes on playing uncertainly for a few notes, then plays a scale up and back.

"All right, that will do," the hypnotist says. "Now stand up and come with me." He leads her to a blackboard. "You are six years old, Margie, and you are standing at the blackboards in the classroom. I want you to write on the board, 'Come to me.'" Margie writes very slowly. When she has finished the demonstrator says, "Now write your name. You are five years old." The girl writes her name, 'Margie.' "All right you can sit down now." The demonstrator helps the subject to her seat, saying, "You are fast asleep. You are all fast asleep. You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.' You are going to remain asleep until I count ten and say, 'All right.'"

Turning to Margie's sister Lisette, the demonstrator next says, "Stand up, Lisette." He helps her out of her seat. "Now, Lisette, I want you to imagine that you are four years old. Tell me your name." "Lisette." "Ask your sister to bring you that little dog." Lisette asks her sister in French, *"Apporte-moie le petit chien."* Margie and Lisette are French. Margie was seven and Lisette five when their parents came to this country. Margie had learned to talk English before she came to America, but Lisette talked in French until she was six.

The demonstrator continues, "When you were five years old, Lisette, you went on an ocean voyage, didn't you?" "Yes." "Imagine you are five years old, I want you to tell me the first thing you did when you woke up on your first morning on the ship." Lisette says, *"Je vois poisson."* "Now imagine you are six years old. Turn around, walk over to the blackboard and take some chalk." The demonstrator assists the subject to the blackboard. "I want you to write your name. You are six years old." With a long rhythmic swing the girl writes "Lisette." "Now write 'Come.' You are four years old." She writes in French—*'Venez.'* Her writing is very childlike. "All right, fine," the demonstrator says. He takes the subject by the hand and says, "Come over here and sit down."

Turning to the five subjects in the hypnotic trance, the demonstrator now prepares to bring the girls out of their sleep. "You are going to wake

very slowly and will feel perfectly comfortable," he says. "You will feel more awake than before you went to sleep. You will continue that way all day. You are going to wake up very slowly and will feel perfectly comfortable, feel perfectly comfortable. You are going to wake up very slowly. You are going to wake up very slowly. One, two, three, four, five, six, seven, eight, nine, ten." The girls come out of their trances, look around in bewilderment, and several of them say, "What happened?"

The class at this point usually expresses a sigh of relief. An animated discussion follows, in which the phenomenon of childhood regression is compared with such other phenomena of hypnotism as post-hypnotic suggestion, anaesthesia, amnesia, catalepsy, etc., which have previously been demonstrated to the class. The discussion of hypnotism at Western College begins with a historical survey, is followed up by demonstrations and further discussion, and ends with a consideration of possibilities for application.

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*Department of Psychology*
*Western College*
*Oxford, Ohio*

*The Journal of Genetic Psychology,* 1945, 67, 91-92.

# BOOKS

The *Journal of Genetic Psychology,* the *Journal of General Psychology,* and the *Journal of Social Psychology,* will buy competent reviews at not less than $2 per printed page and not more than $3 per printed page, but not more than $15.00 for a single review.

*Conditions.* Only those books that are listed below in this section are eligible for such reviews. In general, any book so listed contains one or more of the following traits: (*a*) Makes an important theoretical contribution; (*b*) consists largely of original experimental research; (*c*) has a creative or revolutionary influence in some special field or the entire field of psychology; (*d*) presents important techniques.

The books are listed approximately in order of receipt, and cover a period of not more than three years. A reviewer must possess the Ph.D. degree or its equal in training and experience.

*Procedure.* If among the books listed below there is one that seems important to you, you are invited to write a review of that book. It is not necessary to make arrangements with the Editor. Just send in your review. It does not matter if the book in question has been reviewed before.

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# CRITICAL REVIEWS OF RECENT BOOKS

*The Journal of Genetic Psychology*, 1945, **67**, 93-94.

*(Yerkes, Robert M. Chimpanzee: A Laboratory Colony. New Haven: Yale Univ. Press, 1943. Pp. 321.)*

REVIEWED BY C. R. CARPENTER

Professor Robert M. Yerkes ranks with Parker, Jennings, Holmes, Thorndike and others as a founder of the study of comparative psychology (behavior) in America. He has planned, financed, organized, and directed the Yale Laboratories of Primate Biology. These Laboratories with branches at New Haven, Connecticut, and Orange Park, Florida, have unique facilities for many kinds of investigations in which the chimpanzees are used as subjects.

Professor Yerkes is a strong proponent of coöperative, group research as contrasted with individual research. In order to implement this idea he insists that his selected students and associates work together. In addition, he requires militantly that permanent and systematic records be kept in order to be of value to succeeding investigators and administrations.

Two other principles have served as guides to the work of the author of the book: (*a*) That specimens of animals be selected which are suitable to the problem to be solved, and (*b*) that those organisms, e.g., primates or apes, most closely related phylogenetically to man are most likely to yield data of significance to the understanding of human behavior.

*Chimpanzee* is a written record of results of putting into operation these and many other controlling ideas. Professor Yerkes states in the Preface that he has written the book out of his personal experience and "from the published reports or laboratory records of my research associates and students. . . ." The book, according to the author, is neither a "general account of knowledge of chimpanzees" nor is it "an epitome of studies made in the Yale Laboratories of Primate Biology during my directorship."

The viewpoint of the book is centered and consistently held on the chimpanzee as organism. The reader is never allowed to forget that the chimpanzee is the subject of study while the particular topic may be social behavior, learning, or sensory capacities. The subjects are only rarely reduced to units in a population, but rather individuals retain their identity through a great variety of experiments and reports of these. The subjects are not just so many animals but Pan, Frank, and Mimi, or Josie, Nana, and Don.

The extensive and rich information of the book *Chimpanzee* is arranged in three main parts between the Prologue "Servant of Science" and the Epilogue "The Story of an Idea."

*Part I.* "General Description" depicts the chimpanzee in its native habitat and deals with the problems of adapting it to captivity and laboratory conditions. Intimate descriptions are given of the temperaments of chimpanzees, "good and bad," and of social behavior and relationships. Continuous records covering many years enable Professor Yerkes to write authoritatively and comprehensively on the life cycle and sex differences in chimpanzees. These general descriptions which are unusually well documented lay the basis for the more detailed and intensive reports of the central and main section of the book.

*Part II.* "Mentality" first gives what has been learned about the sensory capacities of the subject ape. The next chapter (No. VII) deals with adaptive behavior or intelligence. The following chapter on learning experiments and theory is, for the psychologist, a principle climax of the book. Learning is classified into five categories: (1) Maturation and exercise, (2) conditioning, (3) "Trial-and-error," (4) direct learning, involving suggestion, imitation, or tuition. . . , (5) ideational learning. Chapters IX and X deal respectively with memory, foresight (anticipatory behavior), insight, and language and symbolism. These subjects have long presented great difficulties to investigators of animal behavior and of brain functions. The results achieved by Professor Yerkes and his associates on these problems demonstrate some of the advantages of having at least one laboratory organization planned for the effective use of chimpanzee subjects.

*Part III.* "Care and Handling" is concerned with chimpanzee husbandry. The topics are housing, feeding, breeding, rearing, and disease control. Those persons responsible for the care of chimpanzees, be they pets or zoological garden or laboratory specimens, will find this section of great practical value. Professor Yerkes indicates, by presenting his solutions to so many problems, his thorough understanding of the needs for normal, healthy animal specimens for research purposes. This is especially important for highly developed and complex monkeys and apes.

*Chimpanzee: A Laboratory Colony* gives an unexcelled account of one of the great apes. In addition the book may be used as a key to an extensive supporting literature. The subject as dealt with by Professor Yerkes relates to zoology, anatomy, anthropology, physiology, medicine, and psychology. The style and terminology will make the book both interesting and understandable to a large audience.

*Capt. C. R. Carpenter*
*Army Air Forces Tactical Center*
*Orlando, Florida*

*The Journal of Genetic Psychology*, 1945, **67**, 95-99.

*(Gesell, A., & Ilg, F. L. Infant and Child in the Culture of Today. New York: Harper, 1943. Pp. 399.)*

REVIEWED BY NATHAN ISRAELI

This work is concerned with the early years of mental development with special reference to culture. A philosophy of child development in democracy is here advanced which is sharply opposed to authoritarian coercion but which encourages recognition of individuality in growth and would hence not sanction too much interference by culture. This outlook is one of faith in the potency of intrinsic growth factors with moderate allowance for extrinsic factors. It deprecates an extreme behaviorist position as placing too much importance on the environment.

In carrying out this basic outlook, the authors include important schedules of development. They describe the behavior profile and behavior day at various stages. Development information is given under various headings including sleep, eating, elimination, bath and dressing, self-activity, sociality, cultural and creative activities such as books, music, painting, finger painting, clay, sand, stones, water, blocks, possessions, excursions, holidays and festivals. Nursery techniques are also outlined including details about physical environment, adjustment, routines, transitions, teachers, humor, other children, and group activity. Growth sequences of personal and social self behavior and of the differentiation of self and others are compared. Information is appended about toys, play materials and equipment for various age levels.

Gesell and Ilg advance interesting points relating to mental development. One of their basic laws is about the recurrence of equilibrium, innovation, integration (and consequent disequilibrium) and equilibrium again. Development then would appear to proceed somewhat discontinuously and unevenly. Frequent deviations are found from the main direction of growth. They assert thus that growth "oscillates along a spiral course toward maturity" (p. 292). That Gesell does not observe any formal continuity of mental development may also be indicated by the statement together with Thompson in *The Psychology of Early Growth* (1938) that "Behavior growth is not a process of augmentation nor is it merely a process of progressive differentiation." There is an overall continuity but there are interim discontinuities. This paradoxical statement is comparable to Hollingworth's position in his *Mental Growth and Decline* in which he first declared

that development is perfectly continuous and later made allowance for a *law of pattern* concerned with new acquisition, change of proportion, dropping of the old, addition of the new, and shift of emphasis. Both Hollingworth's position and that of the present authors warrant both experimental and theoretical attention.

Another law of development set forth by Gesell and Ilg is about the importance of maturation in development. Thus, penetration into cultural areas of greater difficulty and scope deepens primarily with increased maturity. Intrinsic factors are of the greatest importance. Extrinsic factors are important too but "the maturational matrix is the primary determinant of child behavior" (p. 358). This weight was given to intrinsic factors early in Gesell's work. In *The Mental Growth of the Pre-School Child,* it was maintained in 1926 that the "conditioned reflex is significant for developmental diagnosis, because it must correlate in some basic manner with the maturity and the caliber of the cerebrum." Since that time, Gesell has been mainly concerned with maturity and developmental diagnosis but not with conditioning and has followed through with the psychometric method for the study of mental growth which method he then defined as "measuring or grading behavior by means of standardized test procedures" and which "derives its practical significance from the fact that it is based . . . upon the study of related groups of individuals."

Gesell's emphasis on maturation appears in his various reports and publications. He elsewhere criticized the behaviorist theory as an overemphasis on environment and in this book it is again asserted that it takes too much for granted. It appears that there is a certain margin of uncertainty about the meaning of Gesell's hypothesis of maturation and about those consequences that flow from it. He appears to unduly stress inheritance and to be overcritical of environment. He would seem to say that growth and development occur in time—one should leave inheritance alone and just afford it a maximum [illegible]. At the same time, he seems to have sought to fully accredit environment, nonetheless, but to have slighted it. For instance, in 1930 he held that growth resolves the "antithesis of endowment and environment in favor of a unifying dynamic outlook" and that "maturation refers to those phases and products of growth which are wholly or chiefly due to innate and endogenous factors" (*Guidance of Mental Growth in Infant and Child,* p. 275 and p. 277). In the present volume, Gesell and Ilg acknowledge "the profound forces of racial and familial inheritance which determine growth sequences and the distinctive growth pattern of each individual child" (p. 289), thus attaching foremost impor-

tance to the burden of inheritance. In Gesell's narrative of *The Wolf Child and Human Child* (1941, p. 84), he urged that any emphasis upon a "reciprocal relationship between heredity and environment should not, however, blind us to the purity of hereditary factors in the patterning of human behavior." He stated there that it is "the organism and not the environment which has the capacity to grow." But what is clear is that the environment does not remain static or unchanged either but varies continually. His story about Kamala can be taken either to emphasize heredity or to point up the importance of environment—and that exemplifies somewhat the difficulty in overemphasizing maturation as dependent on intrinsic factors. Under the influence of wolf culture, Kamala acquired certain habits and customs of wolves and later upon return to human culture gradually shed her wolf-ways and became more and more responsive to her human environment. She died before completion of her development and adjustment. Her remarkable life history reflects both intrinsic and extrinsic factors.

Woodworth's definition of maturation as consisting "largely in development of the ability to learn" (*Experimental Psychology*) suggests that it is difficult to completely isolate purely intrinsic factors as extrinsic factors come into the picture at all times. The complete exclusion of cultural factors seems mythical. If the authors make an attempt to hold a middle course between laissez-faire and complete intervention in the education of pre-school children, it does not seem to be completely carried out. Their outlook is colored by their stress upon intrinsic factors. Thus they desire that parents and teachers should cultivate *perceptiveness for growth* and that they should know "when to step in with a timely aid or prod, and when to withdraw again." The timely aid or prod by parents and teachers does not appear to suffice. The reviewer does not find this to be very practical, for parents as a whole do more than merely aiding or prodding. That they are altogether in the wrong is not so clear. This uncertainty about maturation is further enhanced by the contrast often made between learning and maturation (Morgan) or by regarding the two as closely interwoven so "that it is at times difficult to determine the relative effects of the two" (Hurlock).

The authors emphasize individual differences in growth and consequently point out that cultural guidance "is essentially individualized. It begins in earliest infancy. It remains individualized not only in the home, but in the nursery school group and in the larger social world" (p. 58). The authors would have culture provide the most favorable conditions for "self-regulation and self-adjustment" (p. 57).

What may be regarded perhaps as a reversal, in a way, of the physical law

of entropy is the view of Gesell and Ilg that development tends towards optimal limits, that there is a basic tendency toward an optimum in all normal growth, and that the "developmental stream keeps flowing onward, seeks an optimal channel and finds it" (p. 347). This law is somewhat analogous to perception of complete or perfect configurations. It should stimulate further research.

The authors regard periods of relative equilibrium in growth as occurring at four, sixteen, twenty-eight, and forty weeks, one year, eighteen months, two, three, four and five years. These periods appear to be rather conventional stopping points and somewhat arbitrary. They remind one of Gesell's earlier views as to a schedule of levels of maturity at three to four months, six months, one, one and one-half, two, three, four, and five to six years (*Mental Growth of the Pre-School Child*). This theory of periods of relative equilibrium expressed in terms of time should warrant further investigation.

There is no precise science of personality types (p. 275) but, nevertheless, the authors believe that children can be differentiated according to their growthsomeness and according to certain basic characteristics. They allude to Sheldon's physique and temperament types. They enumerate such types of children as watching, dependent, sensitive, perseverating, shifting, dominating, submissive, imaginative, realistic, high verbal, and high action children. They describe three different types of children varying according to their manner of growth; namely, the solid, facile, and uneven development types. The *solid type* depends on own resources, waits and bides the time, assimilates gradually, slowly matures, and is cautious and wary. The *facile type* is articulate, knows what is wanted, matures rapidly, is preoccupied with present time and immediate space, is up and at it, doesn't wait, combines and adapts expeditiously. The *uneven type* is both underdemanding and overdemanding, matures irregularly, is undercautious and overcautious, moody, mixed and confused while achieving orientation. It would be interesting if the authors were to apply their experimental data, and present comparative development schedules, for example, for these three different types.

Gesell and Ilg discuss the nursery school. Their statement of qualifications required for a nursery school teacher is most exacting. Again, in a democracy, according to them, the nursery school would not mould standard and uniform behavior patterns but would discover giftedness and would attend to individual differences, and would provide opportunities for the blossoming of innate factors.

In looking toward the future, the authors anticipate a technological plan-

ning which would prize psychological and educational values "particularly in behalf of the infant and young child" (p. 361). They point to the inequalities in our present day social provisions for the preschool child and affirm that *"only through a democratically conceived system of developmental supervision can we attain a more just and universal distribution of developmental opportunity for infants and preschool children"* (p. 360). In the period of reconstruction, Gesell and Ilg expect scientific and practical interest to be intensified in the laws of human behavior and organic growth. At least, they indicate that there is a need for "a much more penetrating knowledge of the mechanisms of mental development and motivation." In an objective spirit, with a feeling perhaps of humility, they indicate that "our present-day knowledge of the personality of infant and child is extremely meager and fragmentary" (p. 359). They look to the post-war epoch for scientific work of considerable importance and for more extensive knowledge of mental development.

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## Child Behavior, Animal Behavior and Comparative Psychology



EDITED BY
CARL MURCHISON







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*The Journal of Genetic Psychology*, 1945, **67**, 105-129.

# STUDIES IN THE INTERRELATIONS OF CENTRAL NERVOUS STRUCTURES IN BINOCULAR VISION: I. THE LACK OF BILATERAL TRANSFER OF VISUAL DISCRIMINATIVE HABITS ACQUIRED MONOCULARLY BY THE PIGEON*

*Department of Psychology, Harvard University*

JACOB LEVINE[1]

## A. INTRODUCTION

In an analysis of the mechanisms of behavior, an understanding of the interrelations of the central nervous structures which are involved is of fundamental importance. The comparative and clinical literature is all consistent with the view that the structural patterning of the central nervous system is the substratum for the organization of behavior mechanism; and basic to any explanation of these mechanisms, whatever its form, must be a spatial representation of the patterns of excitation which mediate behavior. However, the light which anatomic analysis can throw upon the problem is limited and is contingent upon the extent to which such an analysis can be correlated with an understanding of the functional interrelations of the component parts of the system. Unfortunately, even the anatomic facts are entirely inadequate, due, no doubt, to the intricate nature in which the subcortical centers are connected with each other and with cortical areas. But until such time as the functional relations between subcortical and cortical loci are properly worked out, our understanding of behavior mechanisms and nervous integrations must remain incomplete.

Probably the main difficulty which has confronted any attempt to analyze behavior in terms of neural mechanisms has been the fact that behavioral patterns do not appear to be associated with any particular nervous pathway. In the cortex for instance, outside of purely sensory and motor phenomena, psychological events have never been found to be functions peculiar to some special anatomic locus. Aside from sensory and motor deficiencies, few of our tests have been able to reveal any specific intellectual impairment as a result

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[1]The writer wishes to express his gratitude to Professor Karl S. Lashley for his advice and assistance in the conduct of this research. This paper is part of a thesis submitted at Harvard University, June, 1941, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

of cortical insult. To be sure, this lack of success may be due simply to our own lack of ingenuity in setting up proper categories of behavior. But the fact that no memory traces for specific events or habits have been localized in any discrete area of the cortex suggests that either the same trace may be mediated by more than one area in widely scattered regions, or else that the trace is not characteristic of individual neural elements.

Consistent with the notion of the non-specificity of the neural pathway is the evidence for the equivalence of motor reactions and of sensory elements, which Lashley (14) has critically summarized. From the numerous studies concerned with the transfer of training, it is clear that motor habits acquired with one part of the body may be transferred to any other part physically able to perform the task. Thus Lashley (133) has shown that monkeys are able, without any hesitation, to open a latchbox, not only with the hand opposite to the one originally trained to perform the habit, but also with their heads and legs. In these cases it is apparent that the habit may be shifted to motor-neurons which appear never to have been connected with the performance. The evidence, however, does not preclude the possibility of common central connections, but this would mean, as Lashley has pointed out, that common central connections must exist for every motor pathway in the body.

For the equivalence of sensory elements the material is no less convincing. The visual system illustrates this fact most clearly. However, the difficulties in seeking for the mechanisms of behavior in terms of interrelations between nervous structures are also made most evident in vision. It has long been recognized that the point to point projection of the mammalian visual system upon the cerebral cortex is of fundamental functional significance. Yet any explanation in terms of a simple spatial reduplication of the excitation of the retinal elements upon the cortex, as that proposed by Ramony Cajal (3), is discredited by the evidence. The many studies of the equivalence of stimuli show that stimulation of totally different combinations of retinal elements may still evoke the same response. The problem involved here is fundamental, and probably underlies every problem concerned with the mechanisms of behavior. It is this: How is it that physically different stimuli which stimulate totally different combinations of neural elements are able to elicit a constant response? A satisfactory answer to this question would probably settle some of our most perplexing problems in learning, such as generalization and abstraction.

Additional support for the notion of the equivalence of sensory elements is gained by the experiments of Becher (1) in which he showed that habits

which have been established with one portion of either retina are still retained when any other part of the two retinae is used. Lashley (13) has also found that rats, when trained to discriminate two brightnesses with one eye blindfolded, retain the discrimination when the blindfold is shifted to the other eye. Previous destruction of both visual areas has no effect on this transfer. In an analogous experiment, Levine (unpublished) found that rats showed similar transfer of a discrimination of patterns. On the basis of this kind of evidence, it appears clear that excitation of specific neural elements in the retina, at least as far as the mammal is concerned, is unessential for the elicitation of a constant response. But whether this non-specificity bears any connection with the particular anatomic arrangements within the mammalian retina and to cortical and subcortical relations is still an open question.

In a recent experiment, Beritov and Chichinadze (2) reported a finding which seems to be incompatible with the notion of equivalence of sensory elements as it is formulated or at least would limit it to mammalian forms. These investigators found that pigeons which were trained with one eye blindfolded to discriminate various colors did not continue to discriminate when the blindfold was transferred to the other eye. Such a finding, if valid, would mean that for the pigeon at least, habits which are established with one eye are associated with that eye alone. This association is in striking contrast to the findings of Lashley and of Levine with rats, where ability to discriminate visual stimuli was quite independent of which eye was used in training. Some doubt, however, is raised with respect to these results of Beritov and Chichinadze, for, Köhler, in a personal communication, reported finding that a chicken showed perfect retention of a discrimination of two shades of gray paper in a pecking situation when the blindfold was transferred from one eye to the other. If the results of Beritov and Chichinadze are valid, we find that mammals and birds differ with respect to the bilateral transfer of monocularly learned discrimination. The contrary finding of Köhler suggests, in addition, that a similar difference exists among different species of birds, or, alternatively, that stimulus-equivalence of this sort in birds depends upon the kind of differential reaction established.

We are faced then with several questions. Is the equivalence of sensory elements, found in the rat, the monkey, and man, characteristic only of the mammalian visual system? Does such equivalence depend upon a cortical projection of optic fibers (since this does not exist in birds)?

Underlying these particular questions concerning sensory-equivalence in the bird is the much larger problem: What functional significance do the striking differences in avian and mammalian nervous systems possess? The cere-

Several precautions were further taken to make certain that other non-visual cues were not utilized. After each trial, whether or not the platforms were changed, the bird was lifted off the platform and held in the experimenter's lap for about five seconds. For those trials in which the platforms were to retain the same positions as in the preceding trial, the platforms were lifted up and moved around; these movements made noises similar to those made by the actual shifting of the platforms. From its position in the experimenter's lap, the bird could not see these manipulations.

Probably the strongest evidence that the birds were responding to the figures on the stimulus-cards, and to these figures alone, was this: A change in the figures to be discriminated was the only discoverable factor in the stimulus-situation which was sufficient to cause a decisive disturbance in the pigeon's behavior. Apparently the only other factor which could produce a marked alteration in the discriminative behavior of the animal was a change of the blindfold. In short, the essential variables in this experiment appeared to be the distinguishable properties of the visual figures and the differential training of the two eyes of the pigeon.

## C. Experimental Data

### 1. *Experiment 1*

The first experiments were designed to determine whether the pigeon retains a discriminative habit which it has learned with one eye blindfolded when the blindfold is transferred to the other eye. In the first test (Test 1) the birds were trained with one eye covered, then tested for retention when the blindfold was transferred to the trained eye. Failure of transfer of the habit to the untrained eye was indicated by the necessity to retrain the birds in the same situation. This test failed to reveal any significant saving of practice with the untrained eye as a result of the training of the other. It seemed possible that some transfer might still be revealed by interference of conflicting habits, so Test 2 in which the direction training was reversed after shifting the blindfold, was undertaken. No retardation or interference in learning the reversed problem could be observed.

*a. Test 1.* The left eye of each of 10 pigeons was blindfolded and the birds were trained to discriminate a triangle from a circle. The choice of the circle constituted the correct response; that is to say, the circle was "positive."[2] The averages of the learning scores were 198 trials with a prob-

[2]Henceforth, "circle positive" will be used to designate the experimental situation in which the platform having the circles on it is the correct one, and the platform having the triangles, the incorrect one. Similarly, "triangle positive" will designate the reverse experimental situation.

able error of 18.9 and 52.2 with a probable error of 4.2. These scores are tabulated in Table 1.

TABLE 1

EXPERIMENT I, TEST 1

Pigeons trained with left eye blindfolded to discriminate a circle from a triangle, circle positive. Blindfold then transferred to right eye and bird trained in same situation. Scores exclude criterion trials.

| | *T*—trials | | | | *E*—errors | | | |
|---|---|---|---|---|---|---|---|---|
| | Eye blindfolded | | | | | | | |
| | Left | | Right | | Left* | | Right* | |
| Order of tests | First | | Second | | Third | | Fourth | |
| Pigeon | T | E | T | E | T | E | T | E |
| 1. | 160 | 47 | 91 | 39 | 36 | 4 | 82 | 13 |
| 2.′ | 293 | 86 | 160 | 52 | | | | |
| 3. | 200 | 61 | 130 | 50 | 4 | 1 | 24 | 4 |
| 4.″ | 69 | 31 | (60 | 15) | | | | |
| 5. | 65 | 19 | 73 | 11 | 70 | 14 | | |
| 6. | 98 | 24 | 130 | 28 | 30 | 4 | | |
| 7. | 200 | 43 | 70 | 15 | 20 | 3 | | |
| 8. | 370 | 101 | 230 | 83 | 90 | 10 | | |
| 9. | 200 | 59 | 160 | 60 | 20 | 5 | | |
| 10. | 200 | 51 | 160 | 58 | 10 | 1 | 4 | 3 |
| Average | 185.5 | 52.2 | 133.8 | 44.0 | 35.0 | 5.3 | 36.3 | 6.3 |
| $PE_m$ | 18.9 | 4.2 | 13.3 | 6.0 | 5.4 | 0.9 | 3.6 | 1.6 |

*Test for retention of habit.

′Three hundred trials of overtraining were given to this bird before the blindfold was transferred from one eye to the other.

″Died before completion of training after transfer of blindfold to second eye.

The blindfolds were then transferred to the right (trained) eyes of all the birds and left in place for two days. At the end of this adaptation period the 10 pigeons were trained in the same situation as before but with the right eye covered. Any transfer of the habit should be shown by a reduction in the amount of practice required to reach the criterion below that required for initial learning with the left eye covered. Any transfer of the habit should be shown either by immediate, correct response or by a reduction in the amount of practice required to reach the criterion below that required for initial learning with the left eye covered.

Retraining was continued to the criterion with the results shown in Table 1. This relearning required an average of 133 trials and 44 errors. This is a reduction of only 28 per cent over the original learning and is not statistically reliable. There is no evidence of transfer of the habit from the trained to the untrained eye. Finally, these birds were retrained to the criterion of learning, first with the left eye blindfolded and then with the right. The scores are included in Table 1. In contrast to the failure of retention when the blindfold was first transferred to the trained eye,

TABLE 2

EXPERIMENT I, TEST 2

Pigeons trained with left eye blindfolded to discriminate circle from triangle, circle positive. Blindfold then transferred to right eye and bird trained in reverse situation, triangle positive, circle negative.

| | *T*—trials | | | | *E*—errors | | | |
|---|---|---|---|---|---|---|---|---|
| | Eye blindfolded | | | | | | | |
| | Left circle pos. | | Right triangle pos. | | Left* circle pos. | | Right* triangle pos. | |
| Order of tests | First | | Second | | Third | | Fourth | |
| Pigeon | T | E | T | E | T | E | T | E |
| 11. | 90 | 31 | 70 | 21 | 31 | 3 | 44 | 10 |
| 12. | 116 | 38 | 49 | 18 | 0 | 0 | 0 | 0 |
| 13. | 234 | 54 | 114 | 41 | 40 | 9 | | |
| 14. | 200 | 53 | 98 | 30 | 0 | 0 | 35 | 6 |
| 15. | 126 | 36 | 83 | 26 | 0 | 0 | 0 | 0 |
| 16. | 202 | 62 | 102 | 34 | 0 | 0 | 0 | 0 |
| 17. | 100 | 47 | 80 | 23 | 45 | 5 | 0 | 0 |
| 18. | 100 | 29 | 90 | 30 | 46 | 10 | 87 | 20 |
| 19. | 75 | 22 | 129 | 32 | 10 | 2 | 6 | 1 |
| 20. | 323 | 88 | 90 | 21 | 40 | 10 | 100 | 18 |
| 21. | 362 | 70 | 140 | 30 | 1 | 1 | | |
| 22. | 183 | 51 | 230 | 55 | | | | |
| Average | 175.5 | 48.4 | 108.8 | 30.1 | 19.3 | 3.6 | 30.2 | 6.1 |
| $PE_m$ | 19.0 | 3.8 | 9.2 | 3.0 | 4.4 | 1.2 | 10.3 | 6.7 |

*Test for retention of habit.

TABLE 3

EXPERIMENT I, TEST 1

Errors made in first 20 trials.

| | Eye blindfolded | | | |
|---|---|---|---|---|
| Pigeon | Left | Right | Left* | Right* |
| 1. | 8 | 9 | 3 | 3 |
| 2. | 9 | 10 | | |
| 3. | 11 | 11 | 1 | 3 |
| 4. | 11 | 8 | | |
| 5. | 9 | 3 | 6 | |
| 6. | 9 | 5 | 3 | |
| 7. | 9 | 6 | 3 | |
| 8. | 9 | 13 | 1 | |
| 9. | 9 | 11 | 5 | |
| 10. | 8 | 10 | 1 | 0 |
| Average | 9.2 | 8.6 | 2.6 | 2.0 |
| $PE_m$ | 0.2 | 0.7 | 0.5 | 1.0 |

*Test for retention of habit.

TABLE 4

EXPERIMENT I, TEST 2
Errors made in first 20 trials.

| | Eye blindfolded | | | | |
|---|---|---|---|---|---|
| | Left | Left* | Right | Left* | Right* |
| | Order of tests | | | | |
| Pigeon | 1. | 2. | 3. | 4. | 5. |
| 11. | 10 | 0 | 8 | 2 | 3 |
| 12. | 10 | 1 | 9 | 0 | 0 |
| 13. | 9 | 2 | 9 | 5 | |
| 14. | 12 | 4 | 8 | 0 | 4 |
| 15. | 7 | 1 | 8 | 0 | |
| 16. | 10 | | 9 | 0 | 0 |
| 17. | 8 | 4 | 8 | 2 | 0 |
| 18. | 10 | | 7 | 3 | 5 |
| 19. | 8 | 4 | 10 | 2 | 1 |
| 20. | 9 | | 7 | 6 | |
| 21. | 12 | | 3 | 1 | |
| 22. | 9 | | 9 | | |
| Average | 9.5 | 2.3 | 7.9 | 1.9 | 2.1 |
| $PE_m$ | 0.3 | 1.7 | 0.4 | 0.4 | 0.8 |

*Test for retention of habit.

these tests show practically perfect retention with each eye after it has been trained.

As can be readily seen from the table, we find no evidence for any retention of the discriminative habit following the transfer of the blindfold. Three facts in particular point to this conclusion:

(*a*). The two birds tested by critical trials showed no preference for either figure, in spite of the fact that one of them, Bird 8, had received 300 trials of overtraining beyond the criterion of learning before the blindfold was transferred.

(*b*). All 10 birds required almost as many trials and errors to relearn with one eye the habit already acquired with the other.

(*c*). The pigeons showed no noticeable preference for either figure in the first 20 trials of their second training.

The fact that little loss in retention was evident in the final two retraining tests suggests that disturbances in discriminative behavior due to the blindfolds were not responsible for the lack of interocular transfer.[3]

*b*. *Test 2*. Twelve pigeons with their left eyes blindfolded were trained in the same situation as the first group (circle positive). The average learn-

[3]Hereafter, "interocular transfer" will be used to designate the retention of discriminations acquired with the use of one eye when the animal is tested with the other eye.

ing score was 175.9 with a *PE* of 19.0 trials and 48.4 with a *PE* of 3.8 errors. Retention tests two weeks later under the same conditions showed nearly perfect retention.

The blindfolds were then transferred to the right or trained eye. Five of the pigeons were given critical trials in order to test for preference of either figure. Each bird made chance scores indicating no differential reaction to the stimuli. All 12 pigeons, now with their right eyes blindfolded, were trained with the values of the stimuli reversed, namely, triangle positive and circle negative. The training scores averaged 108.8 with a *PE* of 9.2 trials and 30.1 with a *PE* of 3.0 errors. The learning record of each bird is given in Table 2. The second learning scores are no longer those obtained in the previous test where there was no reversal of the values of the stimuli when the blindfolds were shifted to the second eye. They therefore indicate an independence of the two visual habits involving the two respective eyes.

As a further test of the independence of the two eyes in the performance of their specific and conflicting habits, the animals of this group were retrained, first with the left eye covered and circle positive, then with the right eye covered and triangle positive, thus measuring retention of the conflicting habits of the two eyes. Table 2, Columns 3 and 4, give the results of these tests. With each eye the birds showed practically perfect retention of the habit established for that eye.

The results of this test offer additional proof of the absence of interocular transfer in the pigeons used in this experimental situation:

(*a*). There was no retardation in the acquisition of a discriminative habit with one eye which should have conflicted with a habit already acquired with the other eye.

(*b*). There was no evidence of any disturbance in the first few trials of the relearning of the conflicting habit. The average number of errors in the first 20 trials of the original and second learning-situations were $9.5 \pm 0.3$, and $7.9 \pm 0.4$, respectively.

(*c*). The antagonistic habits acquired with the separate eyes were retained without mutual interference, as is indicated by the final retention tests. Almost perfect retention of the appropriate habit was indicated with successive blindfold tests of each eye.

A comparison of the scores of Tests 1 and 2 confirms the evidence for the independent functioning of the two eyes revealed by each test alone. The animals in Test 2 learned the reverse habit as quickly as those in Test 1 relearned the same habit. For both groups there is a small advantage in this

second learning over the original learning, regardless of whether the stimulus situation was the same or the reverse.

A further comparison of the average errors made in the first 20 trials by the two groups reveals no significant difference; all scores are about 10 (Tables 3 and 4). These chance scores confirm the lack of inter-ocular transfer. Additional confirmation is obtained in those tests in which the method of critical trials was used (see Table 2).

The result of Experiment I appears reasonably conclusive. Under the given experimental conditions, learning of a discrimination with one eye does not "transfer" to the other eye. Not only is there no direct carry-over, but there is not even an interference in the formation through the second eye, of a habit which should be conflicting.

### 2. *Experiment 2*

The failure of transfer of the habit from one eye to the other is so different from human experience and from the results reported with infrahuman mammals that it requires very careful verification. Is it an expression of some genuine difference in the organization of the systems of birds and mammals or an artifact arising from special conditions of the experiment? It seemed possible that the performance of the birds might be so unstable that effects of previous training would be abolished by great changes in the total situation, either because the problem set is too difficult or because of emotional disturbances incident upon blindfolding. Tests were therefore devised to determine the influence of the following variables upon the retention of visual habits: (*a*) the complexity of the problem, (*b*) the instability of the birds, (*c*) the affective disturbance of the birds as a result of the blindfolding, (*d*) the reorganization in fixation necessary in shifting the blindfolds from one eye to the other.

*a. Test 1.* That inter-ocular transfer was not obscured by the instability of the birds in such discriminative situations was shown by the following test: Three pigeons were trained to discriminate an upright from an inverted triangle. The upright triangle was the correct one. No blindfold was used at all in this test. The average score learning was 81 trials and 27 errors. The average error score for the first 20 trials was 11. Table 5 summarizes these scores.

Following the acquisition of this habit, the birds were retrained with the triangular figures, but these were now on a background of black and white stripes (⅜" wide) instead of plain black. Also, the inverted triangle was made positive and the upright one negative; that is, the training situation was

TABLE 5

EXPERIMENT II, TEST 1

Pigeons trained with no blindfold. When criterion reached, stimuli reversed and background changed from plain black to black with ⅛" white striations.
Stimulus situation *A*—plain background (black) upright triangle positive, inverted negative.
Stimulus situation *B*—black with ⅛" white striations background inverted triangle positive, upright negative.

| | Stimulus situation A. | | B. | |
|---|---|---|---|---|
| Pigeon | Trials | Errors | Trials | Errors |
| 25. | 90 | 38 | 114 | 50 |
| *E.* | | 10 | | 13 |
| 22. | 64 | 19 | 140 | 52 |
| *E.* | | 11 | | 13 |
| 24. | 90 | 24 | 110 | 42 |
| *E.* | | 11 | | 13 |
| Average | 81 | 27 | 121 | 48 |
| Average *E.* | | 11 | | 13 |

*E.* Errors in first 20 trials.

the reverse of the one in which they had just been trained. The three pigeons averaged 121 trials and 48 errors in relearning this conflicting problem. They averaged 13 errors in the first 20 trials and a large number of repetitive errors which were not included in the records. Particularly in the beginning, the animals were clearly disturbed when forced to make a discrimination, and made attempts to escape.

As was to be expected, relearning was greatly retarded when the value of the stimuli was reversed, for the task was then in conflict with a habit already established. It is then clear from these results, and from observations of the birds in the two situations, that the bird's behavior is consistent and stable enough to show disturbance by a forced discrimination which conflicts even partially with a habit previously acquired.

*b. Test 2.* As a control of the influence of emotional disturbance on shifting the blindfolds, of the degree of difficulty of the discriminative problem, and of the possible disturbances of fixation for detail vision due to changing the blindfold, the following test was devised. Two pigeons which had been trained previously in Experiment I, Test I, were used. They were thoroughly adapted to blindfolding of either eye and had shown perfect retention of visual habits after reblindfolding each eye in turn. They were now trained in the discrimination of an illuminated from a dark platform. This task is a very easy one, for the pigeon does not require accurate fixation.

In a semi-dark room, a 100-watt lamp was used to project a beam of light upon one of the platforms. The variable steps in the training proce-

dure were carried out as in Test 1, Experiment I. That is to say, the training-situation for one eye was the reverse of that for the other. And in order to prevent a stimulus-preference for light from influencing the scores, one animal was trained with the light platform positive and the other with the dark platform positive. Thus, throughout the experiment, what was positive for one bird was negative for the other.

The two pigeons acquired the habit in an average of 54 trials and 17 errors. When the blindfold was shifted to the other eye, both birds formed position habits to the left platform regardless of which stimulus variable was there. They were each then trained with the value of the stimuli reversed. The average learning score of the two pigeons in this reversed problem was 19 trials and 7 errors. Further blindfold tests with each eye showed almost perfect retention of the respective habits.

A summary of the scores of these two pigeons is shown in Table 6. As this table indicates, there was no transfer of the habit from one eye to the

TABLE 6

EXPERIMENT II, TEST 2

Two pigeons formerly trained in Experiment I, Group I, now trained to discriminate a bright platform from a dark one, with left eye blindfolded.
Stimulus situation 0—both stimuli positive.
Stimulus situation 1—light, positive; dark, negative.
Stimulus situation 2—dark, positive; light, negative.
Read down for successive stimulus-situations.

| | Pigeon | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8. | | | | 6. | | | |
| Eye blindfolded | Stim. sit. | Trials | Errors | *E* | Stim. sit. | Trials | Errors | *E* |
| Left | 1 | 79 | 20 | 10 | 2 | 39 | 14 | 11 |
| Left* | 1 | 0 | 0 | | 2 | 0 | 0 | |
| Right | 0 | P.H. to right | | | 0 | P.H. to left | | |
| Right | 2 | 20 | 8 | 8 | 1 | 18 | 6 | 6 |
| Left* | 1 | 9 | 2 | 2 | 2 | 0 | 0 | 0 |
| Right* | 2 | 16 | 3 | 3 | 1 | 0 | 0 | 0 |

*E*. Errors in first 20 trials.
P.H. Position habit to one platform.
*Test for retention.

other. With no signs of disturbance or retardation, the birds acquired with one eye a habit which should have conflicted with that mediated by the other eye.

From the results of this test, the following factors can be eliminated as the casual variables for the absence of inter-ocular transfer:

(*a*). The difficulty of the problem; it was easily learned.

(*b*). A reorganization in fixation entailed by the shifting of the blind-

fold from one eye to the other, for the stimuli were presumably homogeneous throughout.

(*c*). Affective disturbances caused by the blindfolding. The birds in their earlier training had become adapted to the blindfolds and displayed perfect retention of habits when tested.

### 3. *Experiment III: Ocular Dominance in Normal Learning*

In the last two experiments it has been shown that under the given experimental conditions pigeons no longer retained with one eye discriminative habits whiich had been acquired with the other eye. This fact implies that habits established with each eye are independent of each other. From this it should follow that in the normal acquisition of any discriminative habit one of two things ought to happen; either the bird should learn the problem with one eye only, or else it should alternate fixation from one eye to the other until it has acquired the habit with each eye separately. If alternation occurs, the learning score should be greatly increased over the learning with one eye alone, for two independent habits must be acquired. The fact that the animal is learning with one eye should not aid the learning of the same problem with the other. The following four tests were designed to check each of these possibilities in slightly different ways.

*a. Test 1.* Three pigeons, with no blindfolds, were first trained as in the previous experiments with the circle positive. Their average learning score was 149 trials and 47.7 errors. When this score is compared with that in which the birds were trained with one eye covered (average for 22 birds—180.5 trials and 50.3 errors; cf. Experiment I), we observe that there was no retardation.

After learning was completed, a blindfold was put over the left eye of each bird, and retention was tested by giving him critical trials. Only two hours were allowed for adaptation to the blindfold. Birds 18 and 19 chose the circle an average of 83 per cent of the trials; 11 made a chance score, going always to the right hand platform. Immediately following this test, the blindfolds were transferred from the left to the right eyes of the two pigeons, 18 and 19, and two hours later retention was tested. Both birds then made chance scores. The three birds thus failed when tested for retention with one eye. Two, 18 and 19, showed retention with the other eye.

Bird 11 was not immediately tested with his right eye covered, but was next trained in a conflicting habit with the eye which had failed to show retention. With his left eye still blindfolded he was trained with the pre-

viously negative triangle now positive, requiring 57 trials and 16 errors to reach the criterion. Immediately following this training the blindfold was shifted to his right eye and he was given critical trials with the triangle and circle. In spite of the intervening training with triangle positive, he showed perfect retention of the habit originally established with his left eye, choosing the circle in 90 per cent of the trials. Thus he, like the other two birds, had learned the original habit with only one eye, and this habit was not disrupted by reversed training with the other eye. Of particular interest is the fact that two of the birds had acquired the habit with their right eyes, whereas the third learned the problem with his left eye. The results are summarized in Table 7.

TABLE 7

EXPERIMENT III, TEST 1

Pigeons trained with no blindfold, circle positive, triangle negative.

| Situation | Circle pos. triangle neg. | | 10 Critical trials | reversed | | 10 Critical trials |
|---|---|---|---|---|---|---|
| Order of test | 1. | | 2. | 3. | | 4. |
| | | | | Eye blindfolded | | |
| Pigeon | No Trials | Errors | Left | Trials | Errors | Right |
| 11. | 106 | 28 | 5′ | 57 | 16 | 9′ |
| *E.* | | 10 | | | 9 | |
| 18. | 153 | 50 | 9′ | | | 5′ |
| *E.* | | 13 | | | | |
| 19. | 188 | 65 | 15* | | | 5′ |

*E.* Errors made in first 20 trials of training.
'Times circle chosen in 10 critical trials.
*Times circle chosen in 20 critical trials.

*b. Test 2.* Five pigeons were trained to discriminate an upright from an inverted triangle (upright positive). No blindfold was used. The birds learned the problem in an average of 80.8 trials and 26.5 errors. The right eyes of these birds were then blindfolded and critical trials were given. The blindfold on each pigeon was transferred every 10 trials until the animal had been given 20 critical trials with each eye. In every case, a differential response to the stimuli was given under one blindfold condition, whereas under the other, no preference for either figure could be obtained. Thus as in the previous test, under normal conditions of discrimination, pigeons acquired visual habits with only one eye. With the other eye, no differential response to the stimuli was observable (see Table 8).

*c. Test 3.* The possibility still remained that this dominance of one

TABLE 8

EXPERIMENT III, TEST 2

Pigeons trained to discriminate upright vs. inverted triangle, upright positive, with no blindfold. Single figures under critical trials represent number of times upright triangle chosen: Figures below 10—in 10 critical trials; figures above 9— in 20 critical trials.

| Order of test | 1. | | 2. | 3. Critical trials Eye blindfolded | | 4. | 5. |
|---|---|---|---|---|---|---|---|
| Pigeon | Trials | No. Errors | Right | Left | | Right | Left |
| | | | P.H. | | | P.H. | |
| 27. | 90 | 38 | 5 | 9 | | 5 | 8 |
| | | | | P.H. | | | |
| 22. | 64 | 19 | | 10 | | 20 | |
| | | | | P.H. | | | |
| 24. | 90 | 24 | 20 | 8′ | | | |
| | | | | P.H. | | | P.H. |
| 33. | 90 | 32 | 9 | 6 | | 10 | 5 |
| | | | P.H. | | | P.H. | P.H. |
| 26.* | 70 | 18 | 7 | 9 | | 5 | 4 |

P.H. Position habit to one platform.
*This bird was very wild and had to be discarded.
′Out of 20 trials.

eye and the lack of recognition of the stimuli with the other was the result of the bird's lack of familiarity with the experimental situation. The following test precluded this possibility.

In this test two birds were used who had been previously trained in the apparatus. They were Pigeon 11, Test 1 of this experiment, and also Pigeon 10 who had been trained in Test 1, Experiment I.

The two pigeons were trained without blindfolds to discriminate a cross from a square, cross positive. Their average learning score was 64 trials and 24 errors. With a blindfold over his left eye, each bird was given 20 critical trials to test for retention. Pigeon 11 chose the cross 19 out of the 20 trials, and Pigeon 10 chose it 16 in the 20. When the blindfold was transferred to the right eye, both animals made chance scores, as Table 19 indicates.

Thus blindfold tests again show that the birds trained with both eyes open acquired a discriminative habit with only one eye; with the other eye they failed to recognize the stimuli. In addition, the two pigeons used in this test were familiar with the apparatus and no longer displayed any disturbance when placed in it.

*d. Test 4.* The difficulty of the discrimination might possibly have obscured the discrimination of the stimuli with the eye of the bird not used

TABLE 9

EXPERIMENT III, TEST 3

Two pigeons, previously trained in other problems, now trained to discriminate a cross vs. square, cross positive. Numbers under critical trials represent number of times circle was chosen in 20 critical trials.

| Order of test | 1. | | 2. Critical trials | |
|---|---|---|---|---|
| | | | Eye blindfolded | |
| Pigeon | No Trials | Errors | Left | Right |
| 10.* | 58 | 21 | 16 | P.H. 10 |
| 11.** | 70 | 27 | 19 | P.H. 10 |

*Originally trained in Experiment I.
**Originally trained in Experiment III.
'Position habit to one platform.

in training. A test was therefore devised to make the two stimuli as readily distinguishable as possible. It involved the discrimination of a 10-watt light placed over one platform from the other platform which was in comparative darkness. Both platforms were covered with plain black stimulus-cards, and the room placed in semi-darkness. The same procedure of training without blindfold was used, and the pigeons trained to opposite stimuli positive and negative. They averaged 16.7 trails and 7.0 errors in learning this problem.

TABLE 10

EXPERIMENT III, TEST 4

Two previously trained pigeons now trained to discriminate light vs. dark platform, with no blindfold.
Stimulus situation 0—both stimuli positive.
Stimulus situation 1—light positive, dark negative.
Stimulus situation 2—dark positive, light negative.
Read down for successive stimulus-situations.

| Pigeon | Order of test | Eye blind folded | Stim. sit. | Trials | Errors | *E* | Light chosen in 20 trials |
|---|---|---|---|---|---|---|---|
| 21. | 1. | No | 2 | 14 | 8 | 5 | P.H. |
| | 2. | Left | 0 | | | | 10 |
| | 3. | Right | 0 | | | | 1 |
| | 4. | Left | 1 | 16 | 6 | 4 | |
| 11. | 1. | No | 1 | 19 | 6 | 4 | P.H. |
| | 2. | Left | 0 | | | | 10 |
| | 3. | Right | 0 | | | | 20 |
| | 4. | Left | 2 | 13 | 6 | 4 | |

*E*. Errors made in first 20 trials.
P.H. Position habit to one platform.

With a blindfold over the left eye, each of the two pigeons showed no preference for either stimulus and made chance scores in 20 critical trials. But with the right eye covered, they chose the correct platform 19 and 20 respectively in 20 critical trials. Table 10 gives their records.

The results of this test confirm those of the other three tests. Differential reactions are learned with only one eye. With the other eye, the pigeon fails to show any discrimination of the stimuli. We may then conclude from these findings that the pigeon uses only one eye in the normal acquisition of these discriminative responses. The fact that with the use of one eye the bird failed to respond differentially to the stimuli offers further proof of the absence of interocular transfer.

4. *Experiment IV: Shifts in Ocular Dominance in Conflict Situations*

If it is true that pigeons use only one eye in the learning of visual discriminations, the question arises as to whether or not there is a permanent dominance of one eye. There is evidently not a uniform dominance of the same eye in all birds, as suggested by the fact that Pigeons 18 and 19 described above, learned the discrimination with the right eye, and No. 11 with the left eye. During the progress of these experiments, some evidence has arisen which appears to indicate that the pigeon does not possess a permanently dominant eye. The fact that Pigeon 11 had learned one problem with its left eye and another problem with its right, points to such a conclusion. Additional corroborative evidence is suggested by the following two tests, in which pigeons presented with a conflict situation, show a ready shift in dominance from one eye to the other.

*a. Test 1.* The question may be asked: if a bird is trained with each eye separately to master a visual discrimination, will he, when he is presented with a reversal of the problem and allowed to use both eyes, use only one eye in relearning the conflicting problem, or will the original habit be disrupted for both eyes?

In an attempt to answer this question, two pigeons which had previously acquired the same habit (choose circle vs. triangle) independently with each eye in Test 1, Experiment I, were now retrained. They were first tested with no blindfold for retention of the original habit. Both birds showed perfect retention after a lapse of four weeks, choosing the circle without error. Still without blindfold, they were next trained to choose the triangle and avoid the circle. Both birds showed considerable disturbance. Especially in the beginning did they try to avoid making a choice between

the two stimuli and vigorously attempt to escape. But they eventually learned to make the appropriate discrimination.

Critical trial tests by successive blindfolding of each of the two eyes revealed that only one had been used in relearning the reversed problem. With one eye, the birds chose the circle an average of 93 per cent of the trials; with the other eye, they averaged 98 per cent of the trials in choosing the triangle. Thus only one eye was used in relearning the reversed problems. When the other eye was tested, retention of the original habit (circle positive) was shown.

These results offer further evidence that the pigeon uses but one eye at a time. This fact seems to mean that as far as the stimuli of this situation are concerned, the other eye is suppressed or non-functional. It is interesting, however, to note that the experimenter was never able to detect by observation which eye the pigeon was using. The head movements were very rapid, and the non-functional eye appeared to look at the stimuli as often as did the other (see Table XI).

TABLE 11

EXPERIMENT IV, TEST 1

Pigeons, originally trained in Experiment I, with circle positive, triangle negative, for each eye separately, now retrained in reverse situation: triangle positive, circle negative. Single figures under critical trials represent number of times triangle chosen in 20 critical trials.

| Eye blindfolded | No | | | Critical trials | |
|---|---|---|---|---|---|
| | | | | Left | Right |
| Pigeon | Trials | Errors | Errors in first 20 trials | | |
| 1. | 67 | 24 | 14 | 19 | 1 |
| 10. | 95 | 47 | 15 | 2 | 20 |

*b. Test 2.* For further light on this problem of ocular dominance, and in consequence of our finding in the first experiment of this report, we may raise another question: Will birds trained in opposite reactions with the two eyes adjust their reactions to the conditions of reward or punishment more quickly than birds which have acquired the reversed reactions successively with one eye? If so, adaptive dominance may be the reason.

In an attempt to answer this question, two pigeons which had previously acquired conflicting discriminative habits independently with each eye in Test 2, Experiment I, were now retrained. The birds had been trained to choose the circle when the left eye was covered, the triangle when the right eye was covered. They were now given critical trials with both eyes exposed, to see which of the two habits would dominate. No clear preference

for either figure was evidence. The stimuli, as before, were a triangle and a circle.

Still without blindfolds, the birds were retrained with the triangle positive. Immediately afterwards, the values of the stimuli were reversed and the pigeons were again retrained to criterion with circle positive. The first problem was learned in an average of 17 trials and 3.5 errors; the second required 35 trials and 7 errors. Blindfolds were then applied and critical trials given for each eye separately. Both birds consistently chose the circle when one eye was covered, the triangle when the other was covered (see Table 12). Thus the training without blindfolds has failed to disturb or modify the habits previously acquired independently by the two eyes.

TABLE 12

EXPERIMENT IV, TEST 2

Pigeons, originally trained in Experiment I, Group II, in which each eye was trained in circle-triangle problem opposite to that of other eye, now retrained in both situations with no blindfold. Single figures under critical trials represent number of times circle chosen in 20 critical trials.
Stimulus situation 1—triangle positive, circle negative.
Stimulus situation 2—circle positive, triangle negative.

| Stim. sit. | 1. | | 2. | | | |
|---|---|---|---|---|---|---|
| | | | | | Critical trials | |
| Eye blindfolded Pigeon | Trials | No Errors | Trials | No Errors | Left | Right |
| 4. | 30 | 5 | 56 | 9 | 19 | 1 |
| 6. | 4 | 2 | 23 | 5 | 19 | 0 |

The results of this test can be interpreted only by assuming that the learning scores without blindfolds represent the time required by the birds to establish the dominance of the proper eye, and that the reversal of the habit involved, not a relearning with either eye, but only a shift in dominance.

In most cases, when animals are confronted with a situation involving a conflict of habits in a discriminative apparatus, they abandon the conflicting reactions and fall back upon a simple position preference. The pigeons with interocular conflict showed, on the contrary, an alternating preference for the two stimuli, often choosing one consistently for 6 or 8 trials, then the other for an equal period. It is difficult to treat such a performance statistically and the apparent alternate dominance of the two eyes. Whether or not this interpretation is correct, there is certainly no continuous dominance of one eye.

## D. Discussion

On the basis of four general findings the conclusion was drawn that under given experimental conditions pigeons do not display bilateral transfer of monocularly acquired discriminative habits: (*a*) In critical tests (in which pigeons were rewarded for choosing either stimulus) no bird showed any recognition of either stimulus with one eye although he had previously learned to discriminate them with the other eye. (*b*) Pigeons required nearly as many trials to learn with the use of one eye the same habit which they had previously learned with the other eye. (*c*) With the second (originally blindfolded or untrained) eye birds could be trained in a conflicting situation in which the values of the stimuli were reversed over that originally learned with the other eye, without any evidence of retardation or disturbance. (*d*) Blindfold tests following learning of a discriminative problem without any blindfold revealed the fact that the habit was acquired with the use of only one eye. With one eye, discrimination was nearly perfect; with the other, it failed completely.

The experiments described above established the fact that under the given experimental conditions interocular transfer does not occur in the pigeon. A visual discriminative habit which has been learned with the use of one eye is not associated with the other eye. Moreover, the present experiments demonstrate that independence of the two eyes with respect to visual discrimination-learning is to be found not only under conditions where one is used in the learning but also in normal learning involving the use of the eyes. The results all show complete consistence in revealing an absence of interocular transfer.

Control experiments eliminated the possibility that the absence of interocular transfer was due to non-visual or emotional factors, or that the experimental conditions obscured an actual interocular transfer. By the use of pigeons which had already been trained in the apparatus and had demonstrated that they were not disturbed by the blindfolds over either eye, emotional factors were eliminated.

At first glance it would appear difficult to reconcile this finding with the normal behavior of the bird. However, in Experiment III it was demonstrated that pigeons normally discriminate with only one eye. And on the basis of our finding that habits acquired with one eye are not retained with the other, it is not unreasonable to find that since in the normal condition the pigeon discriminates with only a single eye, the bird should fail to react differentially with the eye not used in learning. That has been the finding.

The anatomic and physiologic evidence gives many indications of a similar

independence of function of the two eyes of the bird. The bird possesses no consensual pupillary reflex. In addition, eyelid winks and ocular movements appear to occur independently for each eye. There appears to be little or no interdependence in the reactions of the two eyes of the bird. In this respect, such evidence is consistent with the behavioral findings of these experiments in which no interocular transfer occurred.

In its everyday normal visual behavior, the bird also displays the same independence of its two eyes. When fixating an object, practically all birds, including the pigeon and chicken, do not look directly at it with both eyes but turn the head to one side. They thereby fixate the object with only one eye. In some birds, the herring gull for example, this behavior is very striking. This bird's eyes are placed so laterally, that the head is turned at right angles to the object fixated.

For those birds which possess a single fovea in each eye, the monocular method of fixation enables the image of an object to fall on the fovea, since the single fovea is situated in the upper quadrant of the nasal part of the retina. Even some of those birds, particularly the diurnal birds of prey, which have two foveae in each eye behave in a similar manner.

We may recall the description given by Rochon-Duvigneaud (23), of the pecking behavior of a certain kind of blackbird which possesses two foveae. By inclining its head to one side this bird fixates an object one or two decimeters in front of it. It then strikes with its beak, not directly forward or straight down but from the same inclined position in which the prey was recognized.

Behavior similar to that described by Rochon-Duvigneaud was observed in several of the tests involving the pecking technique. After having a blindfold over one eye for some time, several of the pigeons and two of the three chickens no longer pecked straight down as they did normally. They struck at the grains of corn with the head markedly tipped to one side, that of the free eye. The birds looked as though they were trying to focus the grain with a more nasal portion of the retina.

These observations, suggesting that birds do possess different modes of fixation and that there is a relative independence between their two eyes, lends further plausibility to the notion that lack of interocular transfer may be a normal condition.

And yet, in spite of these observations which are compatible with the foregoing results, a consideration of the difference in structure of the visual systems of birds and mammals reveals no tangible facts which might account for these differences in behavior between bird and mammal. In the bird, all

the optic fibers cross to the other side at the chiasma and course directly to the optic tectum which is the main visual center. In the mammal, on the other hand, not all the fibers cross at the chiasma and few of them go to the small and relatively insignificant tectum; most of the visual fibers go to the greatly developed lateral geniculate body, and from there go on to the cerebral cortex. Thus the geniculo-striate visual system of the mammal represents many changes in size, relative importance, and interconnections over the comparatively simple visual system of the bird. However, these known differences are not adequate to account for the foregoing results nor are any anatomic data concerning the inter-connections of the respective visual systems yet available. A satisfactory explanation of the findings must therefore wait upon further evidence.

In the last experiment, additional evidence was obtained which demonstrate that the pigeon does not possess a permanently dominant eye but periodically shifts from one eye to the other. It was further shown that after birds had acquired the same discriminative habit with each eye separately, if he was then, with no blindfold, retrained with the "polarity" of the stimuli reversed, the bird relearned this discrimination with only one eye. With the other eye the bird retained the original habit.

With the confirmation of the finding of Beritov and Chichinadze that pigeons do show a lack of interocular transfer, the contrary finding of Köhler is still to be accounted for. It will be remembered that Köhler had found that interocular transfer did occur in a chicken when trained in a pecking situation. In the light of our own results, this instance of interocular transfer may result either from the use of a different species of bird, or else from some basic difference in the conditions of the two experiments. In a succeeding paper this problem will be investigated together with further analysis of the conditions under which interocular transfer fails to occur.

## E. Summary

One eye of each of 23 pigeons was blindfolded. Following a two-day period of adaptation, each bird was trained on a jumping stand to discriminate figures or differences in brightness. Upon a shift of the blindfold to the other eye, no bird continued to respond differentially to the stimuli. Failure to discriminate after the change of the blindfold was indicated by the following findings:

1. In critical trials, in which all choices were rewarded, no preference for either stimulus was observed.

2. The number of trials required for the acquisition of the same habit fol-

lowing the shift of the blindfold was nearly equal to that of the animal learning.

3. After the blindfold was changed, no retardation or disturbance was observed in the acquisition of a discrimination antagonistic to the habit established prior to the change.

That non-visual factors were probably not responsible for these results was shown by control tests.

Under more normal conditions, where no blindfold was involved, discriminations were acquired through the mediation of only one eye. With the subsequent blindfolding of the other, normal discrimination persisted undisturbed. This result is consistent with the foregoing findings in showing an independence of function between the two eyes of the pigeon. And yet, neither eye was found to be consistently dominant in every situation. Rather there appeared to be a continual shift in dominance from one eye to the other. The dominant eye at any particular moment was determined either by the conditions of stimulations or by internal factors.

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*Old Farms Convalescent Hospital*
*Office of the Director of Training*
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# STUDIES IN THE INTERRELATIONS OF CENTRAL NERVOUS STRUCTURES IN BINOCULAR VISION: II. THE CONDITIONS UNDER WHICH INTEROCULAR TRANSFER OF DISCRIMINATIVE HABITS TAKES PLACE IN THE PIGEON*

*Department of Psychology, Harvard University*

JACOB LEVINE[1]

## A. INTRODUCTION

Unlike the mammal the bird is not always able to recognize with one eye objects to which it has learned to react with the other. Beritov and Chichinadze (1) reported that when pigeons were trained with one eye blindfolded to go to a food box when a colored figure was projected upon a screen above the box, they showed no evidence of the training when the blindfold was transferred to the other eye. The failure of transfer of discriminative habits from one eye to the other was confirmed by Levine (4). He found that there was not only no transfer of the effects of training from one eye to the other but that the birds could be trained in opposed reactions for each eye with no interference or conflict between the habits.

These observations suggest that, under some conditions at least, the two eyes of the bird are functionally independent and that what is learned with one eye is not transferred to the other.

Using a different experimental technique, Köhler (3) found that interocular transfer did occur in a chicken. He trained the bird to peck grains from one shade of gray paper and refrain from pecking from other shades. This apparent difference between the pigeon and the chicken requires further investigation to determine whether it is due to the methods of experimentation or is a true difference between the species of birds.

The distribution of the foveae in different species of birds is quite variable, some having a single fovea in each eye, others having two, both of which may be circular or one linear, and variously placed. However, the retinal structure of the pigeon and chicken is very similar, both having single,

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poorly developed foveae, and it seems unlikely that minor structural differences will account for the unlike behavior of the two species.

The experiments of Beritov and Chichinadze and of Levine were similar in that the stimuli to be discriminated were displayed on a vertical screen above the level of the ground or perch from which the bird observed them. Köhler's method differed from the others in that the stimuli to be discriminated were horizontal and at ground level. This difference in the relative location of the stimuli with respect to the position of the birds may have been the determining factor for the occurrence or non-occurrence of interocular transfer.

There is considerable evidence that different parts of the bird's retina are markedly different in their functional relations. Many birds possess several areas of acute vision which are often developed as separate maculae and even foveae in each eye. The hawk and eagle, for example, have two distinct, well developed foveae, one located in the nasal the other in the temporal region of each retina. We do not know whether the bird has simultaneous acute vision with all these foveae or whether there is alternation of fixation, but the behavior of some birds suggests a preferential use of one fovea for acute vision, since many birds use monocular fixation except when actually striking at prey.

Since the experiments with the pigeon and chicken have involved stimulation of different retinal areas, it is important to investigate the influence of this variable upon interocular transfer, as a possible means of getting additional information concerning the functional interrelations of the different sensitive areas of the avian eye. A series of experiments to test for interocular transfer in both the pigeon and chicken after stimulation of different parts of the retina has therefore been devised.

## B. Experimental Methods

In these experiments, two completely different methods of training birds to discriminate were used. The first was a pecking technique similar to the one used by Köhler; the other was a modified Lashley jumping stand adapted for birds, and previously described in another paper.

Several variations of the pecking technique were used which depended upon the type of stimulus to be discriminated. The first was essentially that of Katz and Revesz (2) in their study of the pecking behavior of the chicken. The birds were first tested for the preference of grains of corn cut in the shape of triangles and rectangles. A blindfold was placed over the left eye of each bird and he was then trained to peck only the triangular

grains and to avoid the rectangular ones. During training, the negative or rectangular grains were glued to the floor with Duco cement( which when dry was odorless and invisible to the human observer). Later controls, when critical tests for interocular transfer were carried out without the use of the glue, showed that the birds had learned on the basis of the shape of the grains alone and not on the basis of stimuli from the glue. The other pecking method involved the discrimination of one tray of grains from another. If the wrong tray, discriminated either by color or by shape, was chosen, a metal door was dropped in front of the bird and prevented him from feeding. A correct choice was rewarded by allowing the bird to feed for 10 seconds.

As a distinctly different method, the jumping stand was used consisting of a rotating perch from which the bird was forced to jump on to one of two adjacent platforms. The stimuli, usually figures or colors, covered either the horizontal or the vertical sections of each platform. If the animal chose the correct platform he was allowed to remain on it undisturbed for 10 seconds. An incorrect choice was punished by the collapse of the platform under the bird and caused him to fall into a net below. Adequate controls were made for the presence of non-visual cues.

## C. Experimental Data

### 1. *Experiment I*

As a first step in an analysis of this problem, the pecking situation was used to determine whether different species of bird would behave differently with respect to interocular transfer under similar experimental conditions. Three mature chickens and one pigeon, all with left eye blindfolded, were trained to discriminate triangular from rectangular grains of corn.

The four birds acquired the habit in an average of 265 trials and 72.5 errors. After each bird had satisfied the criterion of learning, 20 consecutive errorless trials, an additional 100 or more trials of training was given to insure consistent performance.

The blindfolds were then transferred to the right eye of each bird and critical trials were given. The three chickens chose the originally correct grains (triangles) an average of 77 per cent of the trials. The pigeon gave a chance score in the critical trials. He was therefore trained for reversed reaction with the originally correct grains (triangles) glued to the floor and the rectangular grains now positive. He chose the rectangles only three times in 31 trials in spite of failure to obtain reward by choosing the triangles. Thus, although critical trials failed to reveal a preference for the

TABLE 1

EXPERIMENT I, TEST 1

Birds with left eye blindfolded trained to discriminate triangular from rectangular grains of corn, rectangles correct, triangles incorrect. Critical trials—both stimuli correct.

| Order of test | | Left 1. | Left 2. | Eye blindfolded Critical trials Right 3. | | Reversed training Right 4. | |
|---|---|---|---|---|---|---|---|
| Bird | Trals | Errors | Over-training | Triangles | Rec-tangles | Triangles | Rec. tangles |
| C.16 | 465 | 128 | 172 | 7 | 57 | | |
| C.10 | 86 | 31 | 131 | 7 | 30 | | |
| C. 8* | 379 | 100 | 123 | 54 | 28 | | |
| P.16 | 131 | 31 | 130 | 32 | 25 | 3 | 31 |

C. Chicken.

*Chicken trained in the reverse situation, i.e., triangles correct, rectangles incorrect.

P. Pigeon trained on the jumping stand (see Levine—Experiment I, Test 2).

originally positive shape of grains, reversed training reinforced the original habit and revealed an almost perfect interocular transfer (see Table 1).

This pigeon was subsequently trained on the jumping stand to discriminate figures similar in shape to those used in the previous training on the jumping stand, while one eye was blindfolded. The stimuli were located in the center of both the horizontal and the vertical section of each platform. No evidence of interocular transfer was observed. Not only did the bird fail to recognize the stimuli when the blindfold was transferred to the other eye, but there was no indication of any disturbance or interference when the bird was trained in the reversed situation.

In a second test which more closely paralleled that of Köhler, two pigeons were trained to peck at grains of corn on a tray with a green floor, and to avoid the grain on one with a red floor. As usual, the left eye of each bird had previously been blindfolded. Learning occurred in an average of 129 trials and 43.5 errors. When the blindfold was transferred to the right eye, the birds chose the green tray an average of 78 per cent in 20 critical trials (see Table 2).

A third test with the pecking method confirmed this result and also indicated that the type of stimulus was unimportant. Two pigeons were trained to peck from a white circular container and to avoid a triangular one; both containers were approximately equal in area to the similar figures previously used in the jumping stand where there had been no indication of interocular transfer. The birds learned to respond differentially to these shapes in an

TABLE 2

EXPERIMENT I, TEST 2

Pigeons with left eye blindfolded, trained to peck at grains on green tray, and to avoid those on red tray. Critical trials—number of times the grains on green tray were chosen when both trays were correct.

| | Eye blindfolded | | |
|---|---|---|---|
| | Left | | Right |
| Order of test | 1. | | 2. |
| Pigeon | Trials | Errors | Critical errors |
| 41. | 110 | 30 | 19 |
| 42. | 148 | 57 | 14 |

average of 543 trials and 223 errors. Interocular transfer was shown by the fact that when the blindfolds were transferred to the right eye, the two pigeons chose the circular container an average of 80 per cent of 20 critical trials. The scores are tabulated in Table 3.

TABLE 3

EXPERIMENT I, TEST 3

Pigeons, with left eye blindfolded, trained to peck from white, circular container, and to avoid white, triangular one.
Critical trials—number of times circular container chosen in 20 criticial trials.

| | Eye blindfolded | | |
|---|---|---|---|
| | Left | | Right |
| Order of test | 1. | | 2. |
| Pigeon | Trials | Errors | Critical trials |
| 43. | 452 | 200 | 16 |
| 44. | 634 | 246 | 16 |

With the results of this experiment, the finding of Köhler is confirmed. we must conclude that under the conditions of training similar to those which he employed, interocular transfer does occur, in both the pigeon and the chicken. Interocular transfer in the bird thus appears to be independent of both the variety of bird and the character of the stimulus, so long as this is in the position to be pecked, which is used.

### 2. *Experiment II*

With the elimination of a species difference as decisive in the variability in the occurrence of interocular transfer in the bird, the rôle of the relative position of the stimuli fixated remains to be considered. The variability in transfer has been attributed to the stimulation of different retinal areas by stimuli lying in different regions of visual field. If this assumption is correct, then by shifting the stimuli from one position to some other a change in the bird's visual behavior should be such that whereas in the one case the bird did transfer the habit interocularly, in the other he should fail to do so.

The following experiment was therefore designed to determine the effect of changes in the position of a variety of stimuli upon interocular transfer in the pigeon.

*a. Test 1.* Three pigeons, with blindfolds over their left eyes, were trained on the jumping stand to discriminate a green from a red platform, green positive. Several changes had previously been made in the jumping stand situation for the purpose of more closely paralleling it with that of the pecking situation. First the stimulus cards occupied only the horizontal portion of the two platforms; plain black cards covered the vertical sections. Second, the platforms themselves were raised 5 cm. to a level with the rotating perch, and thus were much closer to the eyes of the bird. Finally, in a manner similar to the previous experiment, the colors also covered the entire area of the horizontal sections and thereby extended to a position directly below the bird's eyes.

The three birds learned the problem in an average of 19 trials and 7 errors. The blindfold of each animal was then transferred from the left to the right eye. All three pigeons chose the green, or originally correct platform an average of 96.5 per cent of the time in 20 critical trials.

Another group of three pigeons was trained in a similar situation except that the platforms were lowered to their original positions. The three birds learned to discriminate the green (horizontal) from the red (horizontal) platform in an average of 17 trials and 7 errors. When the blindfold was transferred to the right eye, they chose the green or originally correct platfrom an average of 95 per cent of the time in 20 critical trials. Table 5 summarizes the scores.

TABLE 4

Pigeons trained on jumping stand with left eye blindfolded, in three training situations, respectively:

(1) green vs. red — green positive — *horizontal* sections of platform only
(2) Circle vs. triangle — circle positive — *horizontal* sections at edge of each platform nearest perch
(3) green vs. red — green positive — *vertical* sections only

*CT*—number of times originally correct stimulus chosen in 20 critical trials.

| Problem | 1 | | | 2 | | | 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Eye blindfolded | | | | | | | | |
| | Left | | Right | Left | | Right | Left | | Right |
| Pigeon | Trials | Errors | *CT* | Trials | Errors | *CT* | Trials | Errors | *CT* |
| 31. | 30 | 9 | 19 | 40 | 16 | 19 | 44 | 18 | 10 |
| 32. | 19 | 7 | 20 | 49 | 18 | 20 | 42 | 16 | 10 |
| 33. | 9 | 4 | 19 | 38 | 16 | 20 | | died | |

TABLE 5

EXPERIMENT II, TEST 1

Pigeons, with left eye blindfolded, trained to discriminate green vs. red platform, green positive, stimuli in horizontal sections only.

Critical trials—number of times green chosen in 20 critical trials.

| | Eye blindfolded | | | |
|---|---|---|---|---|
| | Left | | Right | |
| Order of test | 1. | | 2. | |
| Pigeon | Trials | Errors | Critical trials | |
| 11. | 20 | 10 | 18 | |
| 12. | 8 | 3 | 19 | |
| 13. | 23 | 8 | 20 | |

Thus, simply by varying the conditions of stimulation interocular transfer has been obtained in an experimental situation in which it had previously not occurred.

*b. Test 2.* The question may now be asked: will interocular transfer also occur under similar conditions when the same stimuli are located in a different part of the bird's visual field? The colored stimuli of the foregoing test were moved to a new position. They now occupied the vertical sections of the platforms: plain black cards covered the horizontal sections.

Three pigeons, with their left eyes covered by blindfolds, were trained to discriminate the colors, green and red, as in Test 1. They acquired the habit in an average of 47 trials with 21 errors. When the blindfold was transferred to the right eye, each bird failed to react differentially to either of the colors but instead made a chance score (see Table 6).

For more conclusive proof of a lack of transfer, these three birds, with their right eyes still blindfolded, were retrained in the same discriminative situation as with their left eyes blindfolded. They required an average of 48.7 trials and 17 errors to re-acquire the habit. This score was equal to the original learning score and further proved a lack of interocular transfer. The shift in the position of the stimuli was sufficient to cause a change from transfer to no transfer.

*c. Test 3.* In all previous experiments with the use of the jumping stand and failure to demonstrate interocular transfer, figures and not colors had been used as the stimuli. The training of pigeons was therefore undertaken to discriminate figures in a situation which had previously resulted in no interocular transfer except that the figures were now located in a different relative position. Three birds which had been trained in Test I of this experiment and had transferred the discrimination of colors interocularly in the jumping stand, were retrained to discriminate a circle from a triangle,

circle positive. As before, blindfolds covered their left eyes. The figures in the present test were reduced to about one-fourth of the size of the other tests. Unlike the figures of the latter which were located in the middle of both horizontal and vertical sections, the figures were now placed at the nearer edge of the horizontal sections, and were thus directly below the bird's head when he stood on the rotating perch. A plain black card covered each vertical section. As in Test I the platforms were in the raised position.

The three pigeons acquired the habit in an average of 42 trials and 17

TABLE 6

EXPERIMENT II, TEST 2

Pigeons, with left eye blindfolded, trained to discriminate green vs. red platform, green positive; stimuli in *vertical* sections only.
*CT*—critical trials, number of times green chosen in 20 trials.
*PH*—position habit.

| Order of test / Pigeon | Eye blindfolded: Left 1. Trials | Left 1. Errors | Right 2. *CT* | Right 2. Trials | Right 2. Errors |
|---|---|---|---|---|---|
| | | | *PH* | | |
| 50. | 36 | 15 | 10 | 30 | 13 |
| | | | *PH* | | |
| 51. | 67 | 28 | 10 | 70 | 21 |
| | | | *PH* | | |
| 52. | 38 | 19 | 10 | 46 | 18 |

errors. When tested with blindfolds over the right eyes, all three birds displayed nearly perfect retention of the differential response to the stimuli; they chose the correct figure, the circle, 98.5 per cent of 20 critical trials. Table 6 gives the individual scores.

*d. Test 4.* It will be remembered that interocular transfer was obtained in all tests which involved the pecking method, and this was explained by the fact that in every case the stimuli were located directly below the head of the bird. Consequently, an additional check upon the above relationship would be to test pigeons in a pecking situation in which the stimuli were anterostral to the animal instead of subrostral.[2]

Following the two-day adaptation period to a blindfold over the left eye,

[2] "Anterostral" will be used hereafter to refer to the position of stimuli when they are lying in front of the bird, and the line of regard between the stimulus and the eye forms an acute angle with the ground or is parallel to the ground.
"Subrostral" will be used to refer to the position of stimuli when they are lying directly below the head of the bird, so that the line of regard is approximately perpendicular to the ground.

each of two pigeons was trained to peck through an opening in a yellow card, and to avoid the adjacent opening in a blue card. In other words, the colors to be discriminated in this pecking situation were in the vertical plane in front of the bird. The stimuli were therefore in an anterostral position because they were in front of the bird and the line of regard formed an acute angle and was nearly parallel with the ground. Unlike the experiments where the stimuli lay in a subrostral position the images did not appear to fall in the upper temporal areas of the birds' retinae. Pigeon 41 was one of the birds which had previously been trained in the earlier test where it had shown interocular transfer when the colors were subrostral to the animal (Experiment I).

The two pigeons learned the color discrimination in an average of 236 trials and 81 errors. The blindfolds were then transferred to the other eye, and critical trials were given. Both birds made chance scores and showed no preference for either color. Table 7 gives the individual scores.

TABLE 7

EXPERIMENT II, TEST 4

Pigeons, with left eye blindfolded, trained to peck at grains through opening in yellow card, and to avoid opening in blue card.
Critical trials—number of times yellow card chosen in 20 critical trials.
*PH*—position habit to one card.

| | Eye blindfolded | | |
|---|---|---|---|
| | Left | | Right |
| Order of test | 1. | | 2. |
| Pigeon | Trials | Errors | Critical trials |
| 40. | 212 | 81 | *PH* 9 |
| 41. | 260 | 81 | *PH* 11 |

The results of this test more firmly established the relative location of the stimuli as the crucial variable for interocular transfer. With two entirely different experimental methods, interocular transfer has been shown to occur only when the stimuli are located in a subrostral position.

*e. Test 5.* It would appear from the results of the preceding tests that the plane of the stimuli might possibly be a factor in determining the presence or absence of interocular transfer. If that were the case, then interocular transfer would occur with the stimuli lying in any part of the horizontal plane. In order to check this possibility, therefore, the foregoing stimuli were shifted in their horizontal position from that of the other tests.

Three pigeons, with one eye blindfolded, were trained to discriminate the

smaller figures, triangle and circle, circle positive. But unlike the previous test in which the figures were located at the nearer edge of each horizontal section, the figures here were placed at the farther end of the horizontal section, at the point of juncture with the vertical section.

The birds learned this problem in an average of 120 trials and 51 errors. Following a change of the blindfold to the other eye, critical trials revealed no retention of the habit by either bird; each one formed a position habit (Table 8 summarizes the scores).

TABLE 8

EXPERIMENT II, TEST 5

Pigeons, with left eye blindfolded, trained to discriminate circle from triangle, circle positive. Figures placed at farthest end of horizontal sections of platforms. Critical trials—number of times circle chosen in 20 critical trials. *PH*—position habit to one platform.

| Order of test | Eye blindfolded | | | |
|---|---|---|---|---|
| | Left | | Right | |
| | 1. | | 2. | |
| Pigeon | Trials | Errors | Critical trials | |
| 37. | 126 | 55 | *PH* | 10 |
| 38. | 112 | 45 | *PH* | 10 |
| 39. | 122 | 52 | *PH* | 10 |

On the basis of these findings, we may conclude that the plane of the stimuli is not the determining factor of interocular transfer. The only difference between the conditions of this test in which no transfer occurred, and the one in which it did, is that in the one case the stimuli were located anterostral to the bird and in the other subrostral to him. This test then confirms the others in indicating that the occurrence of interocular transfer depends upon the location of the stimuli, irrespective of the plane in which they lie.

The foregoing tests were repeated with the difference that the stimuli occupied a different position in the horizontal plane.

## D. DISCUSSION

Interocular transfer in the bird appears then to be a variable phenomenon. Under certain conditions it is found that birds will show transfer and under certain other conditions they will not. This variability has been shown to depend upon the stimulating situation and one factor in the situation in particular seems to determine whether or not transfer is to occur. That factor

is the location of the stimuli which are fixated. Thus stimuli which are placed in one position of the bird's visual field are discriminated with either eye in spite of the fact that the habit had been monocularly acquired. In another region of the visual field these same stimuli are recognized only when the eye originally used in learning is involved. Clearly, there appears to be some relation between the fixation area of the bird's retina and interocular transfer.

Interocular transfer then depends upon the position of the stimuli with reference to the position of the bird's head. Therefore, transfer must depend upon the retinal area which is stimulated, occurring when the upper temporal retina is stimulated and failing to occur when fixation is with the lower temporal retina. And neither the character of the stimuli *nor* the mode of response is significant for transfer.

Thus, the most probable basis for the dependence of interocular transfer in the bird upon the method of fixation is that different retinal areas are involved. Determined by the direction of stimulation, the excitation of one area used in fixation may be considered to result in interocular transfer by virtue of direct connections with the corresponding area of the other eye. Likewise, the stimulation of some other retinal area, because it does not have direct nervous connections with the corresponding area of the other eye, does not produce transfer.

Unfortunately, the anatomic evidence is not available which shows any such relationships between different parts of the bird's retina as the above assumption demands. However, the great complexity of the foveal arrangements in various birds does indicate retinal relationships which are far different from those of mammals. Although the functional significance of the diverse kinds of fovea (which range from two separate foveae to long band-like maculae) is still to be determined, the presence of more than one small area of distinct vision suggests alternative regions for accurate fixation. The most reasonable determinant of the use of one of these regions would appear to be the location of the object fixated in the visual field of the bird. The experimental findings are consistent with this conclusion.

## E. Summary

Pigeons which were trained with one eye blindfolded, to discriminate stimuli of various kinds displayed bilateral transfer of these habits only when the stimuli were situated subrostrally to them. When the stimuli were in an anterostral position, no interocular transfer occurred. These

results were obtained with two different experimental methods, a modified jumping stand and a pecking situation.

Neither the kind of bird nor the type of stimulus variable used was found to be an important factor. This relationship between the location of the stimuli in the visual field, and the presence or absence of interocular transfer, was accounted for in terms of the involvement of different retinal regions.

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*Old Farms Convalescent Hospital*
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*Avon, Connecticut*

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# PROCEDURES IN TRAINING TEACHERS TO PREVENT AND REDUCE MENTAL HYGIENE PROBLEMS*

*Los Angeles, California*

DOROTHY W. BARUCH

## A. INTRODUCTION: THE NEED FOR REORIENTATION OF TEACHERS TO REGARD INNER EMOTIONAL CONTENT INSTEAD OF FOCUSING ON OUTER SYMPTOMS

In a world where psychiatrists are far too few and where mental hygiene problems are far too many, it becomes extremely important to explore ways and means of incorporating preventive and therapeutic procedures wherever the kind of relationships implicit in a situation would permit them to function.

The teaching situation is one such place. It is, in fact a strategic place, because of the day by day quality of the relationships within the setting; and because practically our entire population moves through these as a developmental framework.

Teacher-child relationships can either become intensifiers of problems, or modifiers and reducers. If they are to become the latter, if they are to hold therapeutic values, they must be grounded on the teacher's understanding and acceptance of emotional aspects of children's and parents' living.

And yet a tendency to consider and deal with symptomatic behavior, and to disregard inner emotional content, is prevalent and firmly entrenched among school people. Evidence of this comes as one works with teachers in either pre-service or in-service training, as one listens to discussions at teachers' institutes and workshops, as one hears off-guard comments by teachers. It is implicit in observed practices in regular classrooms; even, unfortunately at the nursery school level.

To illustrate: Attitudes appearing in a single round-table discussion several months back were recorded. The group was a typical school group composed mostly of teachers and supervisors. Some of the attitudes expressed may be generalized as follows:

> The maintenance of orderly quiet in the classroom is essential for children's adjustment.
>
> If a child manifests a problem, as for example stealing, the best way to deal with it is to give him plenty of constructive activities.

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Children's fears can be overcome by placing them with calm children who are unafraid. They learn to overcome fear by imitation.

If a child is found to have a "discriminatory" attitude toward Negroes or Japs; Germans or Jews, the thing to do is to let him meet "nice" Negroes or Japs or Germans or Jews. Even at kindergarten level this will teach him that his attitudes were wrong; and will get him over his discrimination.

If you let a child express aggressiveness, the behavior becomes habitual. The child becomes anti-social. Instead you must socialize him and see that he is "controlled" from nursery school on.

There was no understanding of the emotional genesis of the kinds of behavior under discussion. The fact, for instance, that Negroes or Japanese could be symbols on which to let out aggression to a parent or sibling was unrecognized. The fact that engendering quiet, controlled behavior might hide rather than clear a problem was out of the picture. The emphasis was on *repressive, problem-augmenting* techniques. It disregarded acceptance of inner emotions and of *releasing, problem-reducing* procedures.

Such emphasis is wide-spread. School people far too frequently think in terms of external symptoms. This is illustrated in such studies as those by Wickman (13), Ryan (9), and Cutts and Mosley (4). Teachers on the whole focus very little on inner emotions. They, by and large, lack insight into the ways in which children can be helped to work through some of their inner difficulties. They lack acceptance of any hostile emotion; and exclude provision for its release.

The same attitudes ordinarily color whatever work they do with parents. Again common concepts might be generalized as follows:

What parents need is to have better control over their children.

The maintenance of a quiet, calm, unruffled home atmosphere is essential.

Parents should never get upset in front of their children. If they do, they're not good parents.

Parents invariably love their children. Other kinds of feelings are depraved and "wicked."

Teachers need to steer away from parents' emotional problems. The only things which concern them are the child and his behavior.

You can "educate parents" by giving them good, sound advice.

The interrelationship of the parents' emotional difficulties with the child's is not taken into account. There is no cognizance of the fact that parents normally have ambivalent feelings toward their children, or that a reduction of negative aspects can come through "spilling" and facing of feelings rather than through "bottling up" and denial. These and other concepts, widely

accepted in psychiatrically oriented groups, are simply not a part of the teacher's orientation. Therefore, if teachers are to prevent mental hygiene problems from developing or becoming intensified, they must first manage to reorient themselves in regard to them.

Exploration of procedures which will help them to do this is needed. Such exploration was carried on by the writer, first in a Teacher Training Institution. Procedures were gradually developed which appeared to bring hopeful results. Certain phases of the procedures and outcomes have been studied in masters' theses done under the writer's supervision (5, 10) along with the children's progress under resultant practices (6, 10, 12). Later, similar procedures were incorporated into an in-service training program in a Child Care Program set up through the Lanham Act under public school administration.

The present paper attempts to draw together the salient features of the procedures utilized; to describe their effectiveness; and to examine results in the two different situations in which these procedures were tried.

## B. Description of Subjects

In the first situation,[1] the group (Group 1) was composed of students who were taking the final two years of pre-service training, as well as those who had taught previously and were taking advanced work or renewing credentials. In the second situation, the group (Group 2) was composed of teachers working in the three nursery schools, the kindergarten center, and the school-age center which comprised the child care project.[2]

In the teacher training institution, the subjects included were all those students who came for individual counseling during one school year and who, in addition, attended classes and did practice teaching under the supervision of the writer. They were 44 in number.

The series of experiences in which they engaged provided both a closeness and a variety of contacts with the investigator and her staff. The closeness in contacts made it possible to experiment with a number of procedures, as, for instance, devoting all class periods during one course to group therapy; or, giving students opportunity to carry on projective techniques with the children under close supervision. The variety of contacts made it possible for the writer and her staff to observe student reactions closely under a

[1]Broadoaks School of Education, Whittier College, where the writer was Professor of Education and director of the Preschool Department.

[2]Bellflower, California, where the writer was Director of Child Care War Services.

series of circumstances, and provided diverse opportunities to evaluate changes as these occurred.

In the public school situation, the subjects included all those who were on the Child Care staff for a month or longer during the four months' period in which the writer directed both the preschool and school programs. They numbered 21. The majority were on the project for the four months. During this time an in-service program was being carried on, again providing contacts of various sorts during which movement in attitudes of acceptance could be evaluated.

Data concerning age, educational standing, marital status and religion of both groups are shown in Table 1.

TABLE 1

AGES—EDUCATION—PREVIOUS TEACHING EXPERIENCE
(Group One: 44 Subjects and Group Two: 21 Subjects)

| | Teacher institution group | Public school group |
|---|---|---|
| *Age* | | |
| Range | 19 to 38 years | 21 to 52 years |
| Mean | 23.1 | 30 |
| Median | 23 | 28 |
| *Education* | | |
| Sophomore Standing | | 1 |
| Junior Standing | 18 | 5 |
| Senior Standing | 12 | 3 |
| Bachelors Degrees | 14 | 11 |
| Masters Degrees | | 1 |
| *Marital status* | | |
| Married | 4 | 9 |
| Divorced | 2 | 2 |
| Single | 38 | 10 |
| *Previous teaching experience* | | |
| Range | 0 to 10 years | 0 to 17 years |
| None | 38 | |
| Under 1 year | 1 | 3 |
| 1 year | 1 | 1 |
| 2 to 4 years inclusive | 3 | 6 |
| 5 to 9 years inclusive | | 10 |
| 10 years or over | 1 | 1 |

By the time Group 2 was started, procedures which appeared to be effective had been evolved in the teacher training situation. It remained, however, to discover whether the same procedures could be applied; and whether they would be effective among teachers who had been working on the whole for a longer period with more repressive, superficial techniques, who had become oriented to these, and who had gained a certain amount of assurance in utiliz-

ing them. Another aspect was also to discover whether procedures which had been effective over a longer period could be telescoped into the briefer time available on this type of situation; and whether they could be adapted to fit into the overcrowded, overloaded program current in the Child Care Centers under the public schools.

It was not possible to do as intensive work with this second group both because of the time element and because the supervisory staff carried heavier loads. Whereas, in Group 1, all 44 subjects came for counseling; in the second only 12 out of the 21 came. Subjects in the first group spent from 6 to 10 hours a week in class discussion and group conferences; those in the second group from 4 to 6 hours. Courses, and group conferences with the first group extended over a period of nine months; those in the second group over a period of four months. Members of the first group worked for three hours a day five days a week with the children and had more time for records and case study than members of the second group who worked eight hours a day six days a week. Procedures for both groups were, however, essentially similar. Methods of evaluation, as described in the later sections, were essentially the same.

### C. Method of Evaluating Changes in Acceptance of Children's and Parents' Emotional Problems

It is always difficult to evaluate movement and to determine if changes in attitude have been incorporated. Subjective elements inevitably enter. And yet, unless this is attempted, the effectiveness of procedures utilized to encourage movement, cannot be judged.

In both groups under discussion, the subjects were in close contact with the supervisory staff. Their functioning with the children and parents could be continuously observed. Their warmth, their openness, their sensitivity to children's wants, their censorship of aggressive behavior, their awareness of withdrawing behavior, their empathy with other personalities, could all be noticed in their daily work. As parents deposited or called for children, stopping for a few moments talk, as parents left and as teachers turned with interested—or appreciative or sarcastic, belittling comment—attitudes of acceptance or non-acceptance were revealed.

At the nursery school and kindergarten levels, frequent occurrences arise which shed light on attitudes toward nudity, toileting, and such sensory manifestations as thumbsucking and masturbation. The extended care centers for school age children are also particularly productive in calling forth revealing teacher responses. Into these centers come children who have been

in the regular classrooms all day under quite universally repressive discipline. As they enter a "free-er," after-school situation, they swing suddenly to the heights or the depths. Aggressiveness, moodiness, fatigue, and numerous manifestations of tension spring to the fore. The teacher's reactions to all these also comes to the fore. At all levels, the ability to accept or the necessity to reject children's troubles are highlighted.

In class sessions and staff conferences, as free discussion is encouraged, attitudes again come into view. Condemnation of parents as well as of children enters as cases are discussed. Focus on externals comes to light, or appreciation of inner turmoil. Willingness to examine and discuss ideas which are new, rigidity in keeping to ideas that are old, gradual incorporation or continuing rejection of emotionally charged concepts, all show up.

As teachers carry on parent conferences, or conferences with other adults, similar attitudes appear. Since all students in the teacher training group and most of the teachers in the public school group carried on a series of such conferences, progression and changes in ability to accept emotional content brought in by the counselee showed up both in the transcriptions of the conferences and in discussion of them with the supervisory staff.

Especially revealing was the approach to manifestations of hostility. Without exception, all the students in Group 1 and all but three teachers in Group 2 were resistant to accepting hostility in either children or adults. They could not tolerate it to any degree. Destructiveness, fighting, swearing, and the like were simply considered as non-permissible behavior. They were unacceptable. Even more unacceptable, though, were the feelings underneath. It was unthinkable that children could be hostile to parents or siblings; and that adults could have been hostile to their parents or siblings, or were now hostile to their husbands, wives, or children. It was "morbid" and "depraved" to believe that such hostilities were at all common. It was completely unreasonable to suppose that expressions of hostility should be permitted and even more unthinkable to assume that such expression would reduce hostility. The conviction prevailed that expressing it would increase and strengthen hostility and would make it persist. Some of the teachers could never, with the procedures utilized, move beyond such beliefs. Others were able to. The extent to which they were able, was demonstrable throughout their work. The extent to which they were able to accept hostility came gradually to be considered by the supervisory staff as a very real evidence of inner growth.

Similarly it was noted, that as hostility could be accepted, so also, in

general, could other emotional content. Where the teacher managed to "get over" her resistance to hostility, she usually was able to accept a much wider range of inner difficulties. She usually came to understand the emotional conflicts and to remain acceptant of the person in whom they appeared.

This fact supplied the needed measuring rod. All but three persons[3] were, in the beginning, completely unacceptant of hostility. It would be comparatively simple to watch changes in acceptance of this one type of emotion. Any degree of acceptance achieved would actually designate that movement had occurred. It would show whether procedures which had been utilized in an attempt to encourage movement had been at all successful. The assumption could follow that they would—with possible adaptation in emphasis—yield similar results in relation to other kinds of emotion.

In consequence, changes in attitudes to children's and parents' hostility was taken as a measure of movement of acceptance in general. It was separately summarized for each teacher at the termination of the experimental periods. Each teacher was given a composite evaluation on her acceptance of children in terms of whether it had remained *Poor,* or whether it had moved to a designation of *Mediocre* or *Good* as described below. Acceptance of adults was similarly evaluated.

*Good acceptance*

Teacher is usually able to accept hostility and most other so-called "negative" emotions both intellectually and emotionally. Is *consistently* receptive as child (or adult) expresses such emotion. Handles it without condemnation or reproach and is able usually to permit release under suitable circumstances.

*Medium acceptance*

Teacher is able to accept hostility, etc., as above intellectually; still has some difficulty accepting it emotionally. Is able *at times* to be receptive as child (or adult) expresses such emotion; at times still responds with resistance to its expression. Is able sometimes to permit release, but not consistently able.

*Poor acceptance*

Teacher is unable to accept hostility either intellectually or emotionally. Consistently reacts with resistance. Finds it difficult to permit release.

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[3]Even in these persons acceptance was seen to increase in depth as time was spent in the situation.

in the regular classrooms all day under quite universally repressive discipline. As they enter a "free-er," after-school situation, they swing suddenly to the heights or the depths. Aggressiveness, moodiness, fatigue, and numerous manifestations of tension spring to the fore. The teacher's reactions to all these also comes to the fore. At all levels, the ability to accept or the necessity to reject children's troubles are highlighted.

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*Medium acceptance*

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*Poor acceptance*

Teacher is unable to accept hostility either intellectually or emotionally. Consistently reacts with resistance. Finds it difficult to permit release.

[3]Even in these persons acceptance was seen to increase in depth as time was spent in the situation.

## D. Procedures Utilized in Helping Teachers to Understand and Accept Emotional Problems

It is not only difficult to define movement in attitude, it is also difficult to define the procedures which enter in to bring about such movement. The present report does not attempt to offer final definitions. It attempts merely to formulate working categories which may help to implement the less readily formulated dynamic processes whereby progression comes.

Essential procedures obviously consist of providing certain types of *experiences.* Such experiences, however, become subtly different as the attending framework of *personal relationships* is formal or informal, guarded or unguarded, relaxed or tense, acceptant or critical. Similarly, experiences become different as the emphases pervading them are objective or subjective, mechanistic or dynamic. Take, for example, the experience of participating in group discussion. If informal relationships persist, the experience is more relaxed and free. If subjective emphases prevail, the discussants feel easier about bringing in things that have happened in their own lives and their reactions. The relationships make up the culture in which the experiences grow. The emphases help to make up that culture. They give shape and quality to the experiences.

Making possible a certain kind of interpersonal relationship of itself involves procedures which need to be taken into account. So also does the conveying of one or another kind of emphasis. Not only are the *experiences* then important to view as procedures. So also the items which build the kinds of *personal relationships* in which the experiences occur; so also are the emphases which are incorporated throughout the experiences. In the following sections, therefore, these three aspects are taken into account. The types of procedures are enumerated which were considered to play an effective part in bringing about movement in the two groups. They are, of course, interrelated. They are facets of a whole. The assignment of one facet to a certain category does not mean that it might not just as well have been placed under another. The attempt is to arrive at some working formulation of what took place in order that the incorporation of the same procedures in some other situation might be facilitated; not to draw up a hard and fast analysis. In a few instances, it has even seemed best to mention similar procedures in more than one place in order to gain functional emphasis.

### 1. *Provision of Certain Types of Experience*

Instead of merely listing the various types of experience which the teachers underwent, an attempt has been made to group them into combinations

which appeared to possess functional relatedness as they occurred. Loosely, the experiences common to the groups were as follows:

1. Each person carried on actual *work with children.* This was combined with such experience as the following:

*a.* Each teacher was helped to carry on close *observation* of a selected number of children over a sufficiently long time (four to eight months) to afford opportunity for viewing such progress as resulted.

*b.* She was helped in making *case studies* on these same chlidren.

*c.* In individual and group *supervisory conferences,* the problem behavior observed was discussed. Psychogenetic factors were gone into, and the emotional dynamics involved. Individual and group guidance was mapped out. Results were reported back.

*d.* Teachers were given the experiences of incorporating *projective techniques* both in "time alone" (1), (2) with an individual child and in the group situation.

2. All subjects were given the experience of participating in *group* discussion, both in class context and in supervisory group conferences. Within these discussion meetings, the following kinds of experiences in turn took place:

*a.* As cases and problems were brought in, the exploration of *family relationships* evolved. The group had the experience of exploring causal factors underlying emotional adjustments, the dynamics of adjustment, emotional needs, frustrations and their effects, the commonness of ambivalent feelings, of hostility and so on, as these entered into context.

*b.* Again, came the experience of going into *techniques of guidance,* of challenging these, of exploring further. Discussion of release and its importance, expressions of resistances to it, methods of implementing it both in children and adult, were repeatedly "thrashed over."

*c.* With all of this came the experience of *needing to handle a new point of view* which had emotional valence for those in the group—the experience of mulling over, of reacting with disgust or sudden or gradual freeing, or with reinforced barriers and defenses.

3. Simultaneously, the teachers had *contact with the adjustment problems of parents* and/or other adults. This included the following types of experiences:

*a.* As counseling progressed with parents, the teacher who was specifically observing the child, was given *access to the transcription of the parent conferences* which were then in supervisory conferences discussed in detail with her.

*b.* All teachers had *informal contacts* with parents individually and in parent group meetings. This brought chances to hear the parents' point of view, their objections, complaints, worries, demands, etc.

*c.* In addition, some of the teachers *carried on conferences with parents* under close supervision, recording their conferences and going over these carefully. Thus they got suggestions for improving tech-

niques. They talked over their emotional reactions to the parents and to the items which the parents brought in. Most of those who did not have the chance to hold conferences with parents of children in their own schools, carried them on with outside parents or with other adults in order to gain an approximate set of experiences.

4. Most important, the teachers had opportunities for living through the experience of *release for themselves.* This came about very naturally as the above experiences transpired. More specifically, this included the following:

*a.* All participated in the *group therapy* which was incorporated into the group conferences and class sessions.

(1). Opportunities to bring in personal problems came naturally in context of similar problems which were being discussed in relation to some case or some parent's or child's problem. (Frequently group members would say, "That's like me," or "That happened to me." This then became a spring-board for talking further.

(2). Opportunities arose also to compare notes on matters over which individuals had felt guilty (hostility during adolescence, or sibling rivalry) and to discover that others like them had had the same problems.

(3). The more timid were encouraged to open up by virtue of hearing problems similar to their own cited by people whom they knew and respected.

(4). All could be encouraged to talk further, to expand—to let themselves "spill."

(5). Continuous reiteration was made that such spilling releases. Added to this, some had the experience of a gradually growing conviction that it does through the sense of relief which they gained within themselves.

(6). They had opportunities too, to express resistances, and to voice these sufficiently sometimes to reduce or to get rid of them.

(7). Throughout, they had the experience of receiving acceptant and supportive contact.

*b.* Teachers who wished, also had the experience of *individual counseling* on their own problems. This included:

(1). Freedom to talk of whatever disturbed them.

(2). Having someone accessible who was willing to take a listening, non-directing, non-advisory rôle.

The substructure underlying all of the above experiences was a double one: First, the subjects were afforded opportunities to see emotions in process of dynamic functioning in children and adults—both others and themselves. And, second, they were simultaneously helped with interpreting the meaning and reasonableness of what they saw.

As a result, emotional reactions no longer seemed so bizarre, or shame-

ful or "crazy." They became understandable, admissible, and natural under the circumstances which brought them about.

None of the experiences, however, would have been the same, had they not transpired within the framework of very special sorts of personal relationships; and had certain emphasis not been continuously stressed.

### 2. *Provisions of Certain Types of Personal Relationships*

The quality of the relationships which prevailed might best be described as relaxed, friendly, and easy. Moreover, they were such that, in their context, defensiveness might be reduced to a minimum. The individuals concerned tended to know that they had no reason to fear to express their real feelings.

Procedures obviously functioned either within a group (as in classes into which group therapy was integrated and in group supervisory conferences); or they functioned in individual situations (as in the individual supervisory conference or the individual counseling conferences.)

Procedures which helped to create these relationships included such items as the following:

1. *Informality* was maintained throughout. To achieve it:

*a. Ritual was eliminated,* such as taking rôle, holding up hands in class before talking, giving examinations, etc.

*b. Use of given names* was adopted.

*c.* People were encouraged to *talk spontaneously* in group session rather than wait to be called on; being careful only to share what they said with the group as a whole rather than to whisper on the side.

2. People were helped to feel a sense of *freedom to express themselves.*

*a.* They were encouraged to recount their own experiences and responses to situations or conditions similar to those brought up in case context or in discussion of some child's or parent's problem. (Frequently the group leader wondered if "anything like this ever happened to any of you?" . . . "Did some of you have similar experiences, or feelings, in your own lives?")

*b.* Group members were encouraged to *identify* with events and problems cited during discussion (through such questions as: "How would you feel under similar circumstances?" . . . "Imagine yourself in the same spot.")

*c.* When the *expression of feelings which are ordinarily not spoken of* slippd naturally into the context of the discussion, further expression from the group was encouraged.

*d.* There was continuous reiteration of the *commonness and naturalness of the feelings expressed.*

3. Continuous *acceptance* was maintained by such means as the following:

*a.* The supervisory staff endeavored to *really feel acceptance.* To this end, if irritation was felt, or rejection, the staff member feeling this would bring it into staff conference and an attempt would be made to work through the feeling, and to move the focus from annoying symptoms to underlying needs.

*b.* There was continuous conscious effort to eliminate *condemnation, moralizing* and *blame.*

*c.* Criticism, opposition, and *disagreements were welcomed,* respected and taken into account.

*d. Immunity* was guaranteed. Subjects were assured that they would not be penalized for any feelings expressed, that grades or recommendations would not be influenced, and that information concerning what they expressed would not be communicated in any way to the administration.

4. Every attempt was made to safeguard the *status* of each individual.

*a.* Each person was accorded some essential *responsibility* within the group.

*b.* Each had opportunity for some sort of *contribution.*

*c.* The fact was stressed that *knowing is understanding;* and that liking rather than a loss in status results from a realization of peoples' problems.

*d.* In order to prevent loss of status from gossip spreading concerning matters brought out in the group, all members agreed that personal items expressed there would not be repeated but would be *kept confidential.* (They incidentally adhered remarkably well to this agreement.)

All through, these various relationships were cemented by the fact that experiences were common to the various group members. All through, too, they were fortified and made possible by the psychological emphases which prevailed.

### 3. *Major Psychological Emphases*

In very abbreviated form, the following generalizations exemplify the type of emphases which were reiterated continuously. They are stated in terminology approximating that used with the group in order to be more closely illustrated.

1. Emotions are of essential importance in what we are and in what we do.

2. The sort of emotions over which people feel guilty are usually quite justifiable outcomes of the kinds of stresses they have lived through.

3. Emotions can push us into actions and attitudes even though we are not aware of them. (This, incidentally is a very difficult concept for the average teacher.)

4. Many emotions are carried over from childhood.

5. Infancy is a particularly important period to understand. Frustrations occurring during this period may bring devious problems.

6. Normal people normally have problems and many times need help in their adjustments.

7. Talking out feelings—"spilling" to an acceptant person—is one way of getting help. Playing out feelings can help children similarly.

8. Letting out so-called negative feelings is desirable; it reduces the strength of the emotion.

9. After sufficient release, the way is clear for positive feelings to come into play.

10. In children, however, for a time after outlets are permitted, the negative feelings usually increase. This is a healthy sign. It means that the child dares bring out his feelings more directly, and that he *is* releasing them freely.

11. In order to understand children, the teacher must also understand parents. Insight into the stresses and conflicts as well as the emotional satisfactions possible within family relationships is an essential part of the teacher's equipment.

Such emphases were elucidated gradually as the group worked together. Concepts developed as experiences were under way. Ideas new to the group were brought in context with the experience so that they come graphically and in personal terms. In this way they appeared to possess greater reality. Further exploration and new experiencing could then come within the permissive framework of the personal relationships which prevailed.

## E. Outcomes Resulting from These Procedures

What happened as procedures were utilized is given below in two ways. First, through tracing progress in an individual teacher; second by evaluating progress in the two groups.

### 1. *Movement in an Individual Teacher*

How procedures interrelated, how attitudes changed and movement occurred, is illustrated by the following material from one of the teachers in the Public School Group. Three types of material are included. (*a*) A case study made by her, illustrating the type of handling of one child's problems before the experimental period had commenced and after; showing too, the kind of insights and realizations which she achieved; and showing, in addition, the shift in attitude toward the child's mother and the kind of

parent work done. (*b*) Excerpts from the same teacher's conferences with the mother, one conference held near the start of the experimental period, the other later; again illustrating, not only the shift in attitude but the incorporation of that shift into working techniques. (*c*) The teacher's account during interview, supplemented by a written report, interpreting what she felt had brought about changes in her.

The teacher[4] who furnished the material was one of the subjects who had made excellent progress in her work with both children and parents, as well as in her ability to accept and face her own feelings. She was 27 years old; had completed her junior year in college; had worked for two years in occupations outside the teaching profession; had taught one year, was married and had two children of her own. At the outset of the experimental period, she was extremely resistant. Evidence of the growth achieved by this teacher, the insights gained and the acceptance reached—is contained in the case study compiled by her and given below.

### 1. *Case Study*

(Compiled by Subject No. 5, Group 2)

#### *Description of Child*

John was four years and three months old on entrance to nursery school. No health problems were evident. His mother, however, reported extreme constipation. His appearance was attractive. He had dark hair, blue eyes and a round button nose. He was of sturdy build with some evidence of fatigue posture.

#### *Problems Manifested*

John had various problem manifestations. He refused food, disturbed the nap room and objected to all routine. He kicked, spit and slapped smaller children without provocation. At the same time, however, he was unable to defend himself or his rights when children of his own size approached him. He would become hysterical when his rights to a toy were challenged but would make no attempt to regain the article. In the yard, he urinated and defecated. He was curious yet furtive about sex. Use of abusive terms was a favorite device to annoy the teachers and children.

#### *Treatment of Problems Prior to the Experimental Period*

During the first two months of school, the attitude of the staff toward John was one of irritation and condemnation.[5] Since no parent contacts

[4]Acknowledgment for the material and for permission to use it and to cite its authorship is given to June Wilson, whose ability to put into words what transpired and whose effort in doing so bring genuine contribution.

[5]These two months were prior to the period during which the writer came onto the project. It is interesting to note the description of both staff attitudes and guidance techniques employed and to compare them to those which came about during the experimental period and which are exemplified in later paragraphs.

were made, it was assumed that he was an indulged "spoiled" child and that all he needed was to learn to accept authority. Accordingly when he refused food and created a disturbance at meal time he was denied dessert and was moved to a "baby table" where he was punished by being made to wear a bib. Only when he would promise "to be good" and "to eat all his dinner" was he allowed to return.

At nap time when he shouted and annoyed the other children, the teacher would place her hand over his mouth and would say, "If you can't keep your mouth quiet, I'll have to hold it for you." If he thrashed around on the bed, he was turned on his stomach and a blanket was wrapped tightly around him so as to pinion his arms to his sides. The teacher would then forcibly hold him down until he lay still.

He was shaken for hitting children, was told he was "naughty to them" and was "benched" in isolation in order to "think about behaving nicely instead."

His interest in exploring his own body was ignored and avoided. The general policy was to see that he was kept busy so that he would "forget" such activities. When he urinated or defecated in the yard, he was made to clean up, was told that what he had done was "not nice" and was seriously advised to use the toilet.

When he used abusive terms, he was told to stop such "horrid" language. Several times, in addition, his mouth was washed out with soap.

*Changes in Attitude toward the Child's Problems during the Experimental Period*

When the directoral staff changed, supervisory conferences were started both in group meetings and individually as were also a series of class sessions.

Teachers were encouraged to bring up problems. The value of close observation of children and of keeping records was stressed. Cases were discussed. Psychological concepts which came up in connection were enlarged on.

At the same time, the teachers who wished were given the opportunity of having conferences regarding themselves and their own problems. Some of them also started for the first time, under supervision, to carry on counseling with the children's parents.

All these things brought changes in attitudes. John, for instance, no longer seemed merely a naughty child to be punished and condemned. Against the background of his home situation, his problems began to be far more understandable.

In her conferences, John's mother brought out that he was an adopted child. She desperately wished him to be looked at as her own. Not having had a child stood to her as a terrific failure, doubly bad because of her desire to succeed in everything that she undertook. As she talked, her ambivalence to the maternal grandmother appeared—

her dependency on her, and her hostility toward her. She was irritated by the maternal grandmother's criticism and yet wished to prove herself to her by having John be a perfect child. The mother's resentment to the father also came out. She felt that he did not assume his share in raising John, that he never spent time with him and left all responsibility to her.

It was apparent that John lived in an atmosphere of tension. He was pressed beyond endurance to be the "perfect little boy."

Against this background, concrete suggestions were talked through concerning the handling of John's problems. New ways were begun.

*Changes in Handling of Problems*

When John hit a child smaller than himself without provocation, he was assured, "I know that you're feeling mean inside. Lots of poeple feel that way at times. Let's see what you can do about it instead of hitting Louise." He was then given opportunity to pinch a clay effigy, to paint out his feelings, to tell about how he felt, etc.

When he was attacked by another child, or when a toy was snatched from him, and when, in his characteristic way, he failed to stand up, the teacher would say, "You can get it, John. I'll help you." Together teacher and child would go after the aggressor. The teacher was careful to see that John had some part in retrieving the toy. Or, if he was hit, she would encourage, "You can tell him not to do that; you don't like it," or "You can sock him back and make him go away."

At first John's attempts at self protection were feeble, but he soon became stronger and more able to defend himself. As he was able to hit back more directly he became less aggressive to the smaller children.

At meal time, he was no longer urged to eat his food. Messing was no longer curtailed. Dessert was given whether or not he cleaned his plate. For one entire week, he refused his food or messed it up, eating very little.

At rest time, the teacher sat by his cot usually stroking his forehead which he dearly loved, thus helping him to let down and to relax.

He found outlets too in using clay and vigorously destroying the objects he made. One day, when the children were having a sun bath and running through the sprinklers, he commenced to wallow in some wet earth. For many days he revelled in messing in the mud. He smeared it all over him.

When he started to stick mud and stones between his legs and protruding from his buttocks and wanted to examine himself with the mud on him, the teacher asked him if he would like a mirror to see himself better. He proceeded then to make "lots of mud come out of his heinie," laughing uproariously.

One day, he announced in playing with the clay, that he was "going to make worms." He did. Then suddenly, he looked up at the teacher and said to her, in the abusive manner so frequent with him, "You shit ass, you."

The teacher remarked, "You like to call me names, don't you John?"

"Uhummm," continuing to roll worms. Then again, "Hello shit ass. Hello shit ass." Pause and then quizzically, "Will you put soap in my mouth?"

"No," in a friendly way from the teacher.

"If my mama tells you to you will, won't you?"

"No."

After some more worm-making, again, "You shit ass. Will you tell my mama?"

"No."

"Hello shit ass. I like you. Don't tell my mama. I like you. . . . Let's make some more worms tomorrow . . ." and he put the clay away.

At other times John would mash clay figures of mother father or teacher with great glee. He would be reassured that "feeling mean" was the way lots of people felt.

*Progress Noted*

By the end of the four months' experimental period John was able to accept routines easily. He rested without disturbance and often without special adult help. He ate without resistance. He played with other children in group enterprise and was able to confine his expressions of hostility to activities where it could legitimately function.

The mother reported that he woke up smiling in the mornings whereas before he used to wake up screaming and crying. He was less constipated and stopped defecating and urinating in the yard. His use of abusive terms ceased also. Sexual curiosity was no longer furtive but open.

When his rights were challenged, he could defend himself better but he still got tense in the process. Occasionally he still became hysterical and cried for the teacher's help. On the whole, however, he was a far better adjusted person.

His mother seemed readier to accept the problems that remained as sometimes common to many children rather than as a special kind of proof that she had failed in bringing him up. During the conferences, she had "spilled" concerning her various irritations and resentments. That she had gained release was evident in the changes in John's behavior. An interesting sidelight was that the father began spending time with John. He took him to the beach occasionally which both appeared to enjoy.

In the above case report, the changing attitudes and techniques of the reporting teacher stand out clearly. It is difficult to believe that the same person who had carried out the repressive practices four months earlier had been able to move to such great acceptance; that the same person who had blamed the mother for "spoiling" her child, had come to feel also such acceptance of the mother's conflicts and problems.

As still further evidence of change, come excerpts from the reports of two parent conferences. The lack of acceptance, the challenging note, the desire to change the mother, to find out what she had done wrong, with condemnation implicit in such questioning—all these are evident in the first conference. The ability to accept and to listen are evident in the second, held approximately one month later.

In parentheses are the comments which were written in by the nursery school supervisor as she went over the report of the conference. They were used as a basis for discussing the teachers' techniques and attitudes toward the parent; and are given here as interesting side indications of some of the techniques utilized in training.

### 2. *Excerpts from Parent Conferences*[9]

(Held by Same Subject)

After exchange of greetings, the teacher started the conference by saying, "I've wanted to talk with you about John. We, at school have been a little worried about his behavior."

(This puts the mother on the spot. If she feels defensive about John's behavior she will have to counteract what you are saying. Better start by giving her a chance to talk. Might say, "I've been hoping to have a talk with you . . ." and now or later, "You know, these conferences are times for parents to talk about anything they wish, especially anything that bothers or upsets them.")

Mother asked, "What do you mean?"

Teacher, "Well, he seems to resent strangers."

"Yes, I've noticed that he is sassy to the new teacher when I come into the school yard. What does he do?"

Teacher, "Sometimes he hits, occasionally he spits or throws toys. Does he object to visitors that come to your home?"

(You put the conference here on a question and answer basis. Makes for discomfort. Too challenging. Better to avoid direct questions.)

Mother, "Well, we don't have company often, but when we do, well, I guess you would say, he shows off. He laughs and runs around and acts silly. But he hasn't hit anyone."

Teacher, "Could you think of any reason why John would feel that way? Has anyone ever frightened him?"

(Again puts mother on spot.)

"Well," slowly, "I can't think of anything." Pause. "He doesn't like any mention of death. The other day we saw a kitten run over and he was almost hysterical."

Teacher, "Does he still have nightmares?"

Mother, "Not lately. The last few nights he has been restless though. He fell out of bed the night before last. When he had those bad

[9]Made by Gertrude Tipton, then Nursery School Supervisor on the project.

dreams before, he fell out of bed two or three times so I finally moved him into the back bed. After he quit dreaming, I moved him into the front bed again and lately he's been all right."

Teacher, "We wondered if he had playmates at home?"

(Here and above, again your questions make you challenge her, put her on the spot. They steer the conference toward things that bother you vs. things that bother *her*. Better to let her just talk.)

(The conference continues along the same line, the teacher directing the content through a series of questions.)

*Later Conference*

Mother started in that she was tired from work. She liked her job very much when she was busy but now there wasn't much doing and she was very bored. She thinks she will ask for a leave. Pause. Mother seemed hesitant.

Teacher said that it was hard to get started talking. She went on to explain that the counseling situation was confidential. It provided time to talk about whatever the mother wanted. Anything that bothered her, could be brought up. This was the time to get things off her chest, to talk about things that she might ordinarily not talk about. Anything in the past or present. Pause.

(Good. You are defining your relationship here and encouraging her to talk.)

Mother, "Well, she was the baby of several brothers and sisters. They all got along very well but of course there was some trouble between her and her sister. She'd want to wear the fancy clothes the sister was able to get on account of having a job; and then there'd be fights."

Mother, "Her mother had never cared for her father but she hadn't known until when she was growing up." . . . Hesitated.

Teacher, "That sort of thing hurts even then. . . ."

(Good. You spoke to her feelings, acknowledging them.)

Mother, "Yes, it did." She'd had no idea that anything was wrong. Her mother and father got divorced finally. . . . Pause. . . . Another thing she herself had been married and divorced once before her present marriage. The only emotion she had felt when the marriage was over was hurt pride. She was very young at the time.

Teacher, "We don't like to feel hurt, or bad, so we often don't admit how much we do feel."

Mother, "Yes. She guessed she had felt bad. It was hard to fail at something she should have succeeded at. Pause. She lived in a small town and everybody knew about it so it was hard to face all of them. She was too sensitive. Too sensitive too about John's adoption. She wanted the same recognition for him as if he were her own. She often felt slights where none was intended. Her mother was very much against the adoption. She and John never got along at all. Her mother had come out from the east a few months back to visit and had intended to stay a long time, but then she went away soon. I

was very disappointed that she didn't stay longer. But (pause) in a way I guess, well, it was a relief. . . . Wasn't it terrible to feel that way?"

Teacher. Worker said she realized that people felt badly when they felt that way, but that such feelings were very natural. Many daughters felt that way. It was natural for the mother, too.

Mother. Looking relieved, "I guess so."

(Again, the conference proceeds all through, along similar lines, the mother talking more and more freely about her feelings, the worker listening acceptantly and talking to the feelings which the mother brings in.)

As in the case study, the citations from the two conferences, show the changes that have taken place in the teacher and in her work. It is interesting to put side by side with the above, the teacher's own account of how the changes came about for her during the training period.

3. *Individual Teacher's Account and Interpretation of Procedure which Brought about Movement*

I couldn't take things at first. I felt, and so did the other teachers that it was a depressing and morbid idea that people felt hostile. We felt that allowing expression of hostility would make it persist, in fact, would augment it. I know now, my reason was that I was so afraid to accept hostility in myself. It was probably the same with the others. I'd had plenty of hostile feelings toward my mother; but I'd never dared admit them. And talking about hostility and admitting its existence in other people, opened the possibility of its existing in me.

As a child, you see, I'd gotten the notion that hostile feelings were bad, not acceptable. I'd been afraid of course to admit such feelings in myself. I felt that I'd be bad simply because of there being bad things in me. They'd be proof that I was bad. Denying them let me fool myself into feeling myself a better person.

Now, though, I don't any longer feel they're depressing. They don't seem bad any more to me. They've become—well, *reasonable. Explainable.* I've come to realize how terribly normal I was instead of being queer or wicked.

As the in-service training went on, all of us teachers began to see how important it was to look at causal factors in judging a child's behavior. But, I can't tell you how hard it was to accept the fact that expressions of hostility and aggression were natural and needed to be released. When you made the statement in a group meeting that all children felt some measure of resentment in our culture, we rejected the concept as too depressing and just too morbid. It was just another "crack-pot" theory. We weren't going to let children express such feelings. It would harm their future development. All of us believed that it would be bad for them to tell them that it was natural to feel hateful, because then there'd be no reason for them not to go ahead

and express hatred continually. We didn't realize until later, the obvious fact that the children *were* expressing hostility in their actions all along whether we admitted it or not. We felt stupidly that the best way to handle any incipient expressions was to let a child know how unacceptable it was to society. Then, we supposed, he would dispense with it on the basis of intelligence.

I don't know what first made me feel differently. I guess everything went together. As we went on talking in classes and supervisory conferences, I got sort of used to the idea. I think spilling about my resistance to it helped to get rid of the resistance.

And, then, too, when I saw it begin to work, that did a lot. As I got to thinking, I had a feeling we weren't handling the children right, and so I started to try it. With John, for instance. After the first few outbreaks of aggression in which we were acceptant, he went overboard. But then we noticed that his periods of aggression became shorter and further apart. Keeping records helped to know just what was happening and to see more clearly how he was getting along. You notice a lot of things you never knew existed, when you start to write them down. Meanwhile, what with a good deal of further discussion in group meetings and in individual supervisory conferences, we began to see that John was being pressed by us at school just as he was being pressed by his mother at home. Poor kid! We began to feel sympathetic instead of harrassed.

Then, after a little while, incorporating play therapy with the children was easy, clear, reasonable, more direct than making them hide their feelings and covering up. You could actually see them changing. Accepting their feelings gave them such release. You could see how much happier and easier they were than when their feelings had been pushed back. Not that we didn't get angry any more! We did—and were more able to admit it. But it helped us to be able to come in and "spill" about getting angry without anyone getting angry at us. That seemed to free us from "taking it out" on the children.

As I said, the class discussion helped too. It fitted in. It was still another means of getting things clear. I was getting them in lots of different ways.

I noticed particularly how you helped people to put their own experiences and feelings into the discussions. Remember the case of Louise? (A child of nine in one of the school age centers who had been stealing.) Eugena presented her case—with all those pressures in it; her father beating her, her mother not loving her, her family being so isolated in the community and hating everybody, her teachers picking on her, the children at school using her as a scapegoat, her folks not getting along with each other. . . . I remember how—when we were all feeling how impossible she was—you asked, "How would you feel if the same things had happened to you?" And all our answers: "I'd hate everybody." . . . "I'd do as many mean things as I could and still get by." . . . "I'd hate the whole world." . . . "I'd feel like fighting." . . .

"I'd go into a corner and hide and not ever want to face anybody." . . . We were reacting with real feeling, not with intellectual replies. We *were* that child for the time being; and she was us.

My own counseling, I think, helped more than anything.

Although it was extremely painful, I felt I had to go on and get to understand myself. My own counseling experience also helped me understand other parents and what they went through in their counseling. For instance, when I felt resistant, I'd go in and talk about all kinds of unimportant details. At first, I felt that I was losing status by having so much known about me. But I soon got over that and began to see that I was liked more for being understood, not less.

I think my supervisory conferences helped because in them I established myself as a person in talking over problems that I was beginning to see and cope with in regard to handling the children. They gave me a kind of status to help me tide over the short period in which I was feeling a loss because of having given away what I thought was the worst side of myself..

But truly, I think my counseling helped me more than anything. The recognition of my own feelings of hostility brought greater understanding of the children's. I could now accept a child, for instance, like John. As I was able to face my own feelings, I also gained greater insight into the emotional complexities and ambivalences of the parents with whom I was counseling.

Incidentally, doing the counseling with parents helped me grow too. At first, I couldn't see how a non-directive sort of counseling could help. I'd been in a couple of courses which had supposedly taught counseling techniques. Only they had all been of the directing type. I felt insecure at the loss of the superiority and prop that directing gives you. I didn't want to accept what Rogers had to say (8). And then, I guess as time went on, I did begin to see what happened, how much easier and relaxed people seemed to get.

The acceptance of hostility in others and in myself became easier and easier as I realized the importance of release. As my own personal counseling progressed, I became more aware of the techniques used by the counselor and their effect on me. These same techniques were discussed in class sessions and in supervisory meetings. The use of pauses, the restatement of the parents' own statement so as to clarify them, and the acceptance of feelings without condemnation were some of the phases discussed. I became gradually able to realize the importance of feelings as the real motivating factors. I became able to focus on the feelings expressed rather than on the intellectual content of the words.

It's impossible now not to be conscious of feelings. It's impossible not to believe in release. I realize so well that it's harmful to deny what's really there. It's wrong not to let it come out and be reduced if it's something that's hurtful. Closing your eyes to it never can help. How

> I ever thought it could is beyond me. As you work with children and parents and let things come out, you see how negative feelings do reduce rather than become augmented. You see more positive emotions coming into the picture. It would be impossible for me to go back and to work now in any other way.

In the conference material above, in the case study, and in the subject's report of what had happened to bring about movement, very great shifts in attitude are evident. Great growth in acceptance of both child and parent stand out. Other group members might have been chosen and similar material presented. For, as is shown in the following sections on the sample as a whole, several individuals made similar progress.

### 2. *Progress as Noted in the Two Groups*

*a. Movement achieved in acceptance of children and adults.* As will be recalled, a teacher who was able to maintain *Consistent* acceptance of children or adults, as specified, was designated as having achieved Good acceptance during the experimental period; the teacher who was able to be acceptant *at times* was designated as having achieved Medium acceptance; one who still found difficulty in accepting negative emotions was designated as having Poor acceptance. In other words, those with Good acceptance had moved forward considerably. Those with Medium acceptance had moved forward to lesser degree, but they had nonetheless also evidenced movement. In contrast, those whose acceptance was indicated as Poor had remained static and had not shown enough movement to evidence any real growth.

In these terms, progress can be summarized as follows (see Tables 2 and 3):

TABLE 2

MOVEMENT IN ACCEPTANCE

(Group One: 44 Subjects and Group Two: 21 Subjects)

| | Acceptance of children | | | | Acceptance of adults | | | |
|---|---|---|---|---|---|---|---|---|
| | Movement | | No movement | | Movement | | No movement | |
| Group I (44) | *N* | % | *N* | % | *N* | % | *N* | % |
| Good | 23 | 52 | | | 19 | 43.3 | | |
| Medium | 10 | 23 | | | 9 | 20.4 | | |
| Poor | | | 11 | 25 | | | 16 | 36.3 |
| Total | 33 | 75 | 11 | 25 | 28 | 63.7 | 16 | 36.3 |
| Group II (21) | | | | | | | | |
| Good | 15 | 71.4 | | | 9 | 43 | | |
| Medium | 3 | 14.3 | | | 7 | 33.3 | | |
| Poor | | | 3 | 14.3 | | | 5 | 23.7 |
| Total | 18 | 85.7 | 3 | 14.3 | 16 | 76.3 | 5 | 23.7 |

TABLE 3

MOVEMENT IN ACCEPTANCE
(Groups One and Two Combined, 65 Subjects)

| | Acceptance of children | | | | Acceptance of adults | | | |
|---|---|---|---|---|---|---|---|---|
| | Movement | | No movement | | Movement | | No movement | |
| | *N* | % | *N* | % | *N* | % | *N* | % |
| Good | 38 | 58.5 | | | 28 | 43.3 | | |
| Medium | 13 | 20.0 | | | 16 | 24.7 | | |
| Poor | | | 14 | 21.5 | 44 | 68.0 | 21 | 32.0 |
| Total | 51 | 78.5 | 14 | 21.5 | 44 | 68.0 | 21 | 32.0 |

In Group 1, the Teacher Training Institution Group, among the 44 subjects, 33 (or 75 per cent) moved forward in their acceptance of children; 28 (or 63.7 per cent) moved forward in their acceptance of adults.

In Group 2, the Public School Group, among the 21 subjects, 18 (85.7 per cent) moved forward in acceptance of children; 16 (76.3 per cent) in their acceptance of adults. In Group 1, 11 (25 per cent) made no movement in acceptance of children; in Group 2, 3 (or 14.3 per cent) made no movement. In Group 1, 16 (36.3 per cent) made no movement in acceptance of adults; in Group 2, 5 (or 23.7 per cent) made no movement.

In terms of whether they moved to Good or Medium acceptance: In Group 1, 23 (52 per cent) reached Good acceptance of children; 10 (23 per cent) Medium acceptance. In Group 2, 15 (71.4 per cent) reached Good acceptance; 3 (14.3 per cent) Medium. In Group 1, 19 (43.3 per cent) reached Good acceptance of adults; 9 (20.4 per cent) Medium acceptance; while in Group 2, 9 (43 per cent) reached Good acceptance, and 7 (33.3 per cent) Medium acceptance.

Taking the two groups together and combining results: Among the 65 teachers, 51 (or 78.5 per cent) evidenced movement in acceptance of children; 44 (or 68 per cent) showed movement in acceptance of adults. In relation to children, 38 (58.5 per cent) showed Good acceptance; 13 (or 20 per cent) Medium acceptance. In relation to adults, 28 (or 43.3 per cent) showed Good acceptance; 16 (or 24.7 per cent) Medium acceptance.

From this, it appears that the procedures utilized were effective to an appreciable degree in helping teachers to accept children. It appears to have been somewhat more difficult for them to reach a similar degree of acceptance of adults. However, procedures were apparently also conducive to growth in this direction.

*b. Allied considerations: Related factors.* In terms of qualitative considerations, the supervisory staff felt that had the second group had more time, their progress might have been deeper; that in the first group those

who did move to Good acceptance had, on the whole, gotten something more stable. Where more time was available for training purposes, it seemed conducive to firmer realizations. A more refined type of rating would possibly have shown this up. However, even in the longer term, some teachers had failed to move. Time itself was apparently not the only consideration. Even in as brief a time as four months much progress had taken place and deep realizations had been achieved among some of the subjects. What were discernible factors, other than the time element, which might be related to the achievement of consistent (Good) acceptance?

Were those who reached Good acceptance younger in years? Were the older ones perhaps less "teachable"? Did age appear to bear influence?

Had those who reached Good acceptance taught longer? Or, were the newer teachers who were perhaps not so entrenched in long-used techniques, more capable of growth?

Was the personal adjustment of the teacher herself a factor? Were those who entered the experimental period with better adjustment in their personal lives, possibly also the ones who were able to reach a more consistent degree of acceptance?

Were those who made the greatest movement in their own personal adjustment during the training period the ones who became most acceptant?

Each of these considerations was in turn explored.

(1). *Relation of age to acceptance.* In order to explore this question, the subjects in both groups were combined. Those who were under 30 years of age were then compared to those who were 30 and over.

There were 53 teachers under 30; 12 teachers 30 or over. Of the 53 under 30, 31 (58.6 per cent) reached Good acceptance of children. Of the 12 who were over 30, 7 (58.4 per cent) reached Good acceptance. Statistically, there was no significant difference between the older and younger teachers in their ability to move to consistent acceptance of children (see Table 7).

As to acceptance of adults: There were 26 (49 per cent of the under-thirties who moved to a Good acceptance; whereas four (33.3 per cent) of the over-thirties moved to similar acceptance. Again, no significant difference appeared between the older and younger teachers (see Table 8).

(2). *Relation of length of teaching to acceptance.* Since very few of the subjects in Group 1 had done any previous teaching, computation concerning this factor was made on the basis of Group 2 only. Of the 21 subjects in this group, 10 had taught under five years; 11 had taught five years or longer.

In relation to children, 8 (80 per cent) of those who had taught under five years moved to Good acceptance, as against 7 (63.5 per cent) who had taught five years or longer. No significant difference was discernible between the proportion of those who reached Good acceptance and who had taught under or over five years (see Table 7).

In relation to adults, 5 (50 per cent) of those who had taught less than five years, and 4 (36.3 per cent) of those who had taught longer, reached Good acceptance. Again, no significant difference appeared (see Table 8).

(3). *Adjustment at beginning of experimental period and its relation to acceptance.* In order to explore this question, a method of evaluating the teachers' personal adjustment reported in an earlier paper (3) was applied. According to this method, the adjustment of each teacher was evaluated by composite judgment of the supervisory staff; and was coded as follows:

> *Uv* signified that the teacher was considered at the beginning of her contracts to be very unadjusted.
>
> *Um* signified that she was considered unadjusted to a medium degree, i.e., somewhat unadjusted.
>
> S indicated that her personality adjustment was considered satisfactory or good.

For purposes of comparison, the two groups in the present study were combined and *Um* and *Uv* were placed together under the heading of "Unadjusted." Those who were unadjusted at the start of the experimental period were then compared to those who had evidenced a satisfactory adjustment.

Among the 65 subjects, 48 were unadjusted at the beginning of the experimental periods; 17 were satisfactorily adjusted.

In relation to children: 27 (56.2 per cent) of those originally unadjusted were able to move to Good acceptance; 11 (62.5 per cent) of those who were originally satisfactorily adjusted moved similarly. Again, no significant difference appeared (see Table 7).

In relation to adults: 19 (39.6 per cent) of those who had been unadjusted; and 9 (53 per cent) of the satisfactorily adjusted ones moved to Good acceptance. Once more, differences were not significant (see Table 8).

Apparently none of the foregoing factors had any significant relationship to the teachers' ability to become acceptant of children or adults.

Obviously, however, the adjustment status at the beginning of the period was only a part of the story. Another part had to do with changes that occurred during the experimental periods in the personal adjustment of the teachers. How about the relation of movement in their own adjustment

to the movement that had occurred in acceptance of children and adults?

To gain an indication as to this, further codings were added and examined. These showed the movement that had occurred by the end of the experimental periods. Again they were done in accordance with details outlined in an earlier paper (3). In brief, they were as follows:

> *O* was used to indicate no progress (i.e., the person had not seemed to move forward at all; was basically the same.
>
> *F* indicated that Fair adjustment had been achieved. (Problems were still present, but on the whole the person had come to function fairly adequately and appeared to be less handicapped by the problems.)
>
> *G* indicated that Good adjustment had been achieved. (Problems were somewhat noticeable still, but the person had come to function successfully and appeared a good deal less handicapped by the problems.)
>
> *E* indicated that Excellent adjustment had been achieved. (Problems had come to be barely in evidence if at all. Progress was marked. Person had moved forward and had become extremely successful in her functioning.)

Thus, staff evaluation which read *UvO* signified that the person was considered to have been very unadjusted at the beginning and had demonstrated no observable movement in her own adjustment. *UvF* signified that the person had originally been considered very unadjusted but had moved to Fair adjustment; *UvG*, very unadjusted and had moved to Good adjustment, and so on. Persons who were considered Satisfactorily adjusted were indicated all through by an *S*.

As acceptance was compared to movement in the subjects' own adjustments, some tremendously interesting relationships were seen. They will therefore be considered in greater detail than the foregoing items.

(4). *Relation in movement in the teachers' own adjustment to movement in acceptance of children and adults.* The relationships of movement in the individual's own adjustment to the movement observed in acceptance of children and adults is shown on Tables 4, 5, and 6. Table 4 shows what happened in Group 1, Table 5 what happened in Group 2. Table 6 combines the two groups.

It will be noted in those persons who were unadjusted in the beginning and in whose personal adjustment no movement occurred, that not one was able to reach Good acceptance of either children or adults. All in the teacher training group (Table 4) remained poor in their acceptance. In the public school group (Table 5), only one moved to a medium degree of acceptance.

Where the unadjusted teachers moved to Fair personal adjustment, acceptance became slightly better. In the two groups combined (Table 6)

TABLE 4
RELATION OF MOVEMENT IN OWN ADJUSTMENT TO ACCEPTANCE
(Group One: 44 Subjects)

| Pers. adj. | Sub-jects | Acceptance of children | | | | | | Acceptance of adults | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Good | | Medium | | Poor | | Good | | Medum | | Poor | |
| | *N* | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % |
| Unadjusted, no movement (*UvO:UmO*) | 4 | | | | | 4 | 100.0 | 0 | | | | 4 | 100.0 |
| Unadjusted moved to fair adjustment (*UvF:UmF*) | 13 | 4 | 30.8 | 5 | 38.4 | 4 | 30.8 | 2 | 15.5 | 2 | 15.5 | 9 | 69.0 |
| Unadjusted moved to good adjustment (*UvG:UmG*) | 6 | 4 | 66.7 | | | 2 | 33.3 | 3 | 50.0 | 1 | 16.7 | 2 | 33.3 |
| Unadjusted moved to excellent adjustment (*UvE:UmE*) | 10 | 9 | 90.0 | 1 | 10.0 | | | 9 | 90.0 | 1 | 10.0 | | |
| Satisfactory adjustment *S* | 11 | 6 | 54.5 | 4 | 36.4 | 1 | 9.1 | 5 | 45.5 | 5 | 45.5 | 1 | 9.0 |

TABLE 5
RELATION OF MOVEMENT IN OWN ADJUSTMENT TO ACCEPTANCE
(Group Two: 21 Subjects)

| Pers. adj. | Sub-jects | Acceptance of children | | | | | | Acceptance of adults | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Good | | Medium | | Poor | | Good | | Medum | | Poor | |
| | *N* | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % |
| Unadjusted, no movement (*UvO:UmO*) | 3 | | | 1 | 33.3 | 2 | 66.7 | | | 1 | 25.0 | 2 | 75.0 |
| Unadjusted moved to fair adjustment (*UvF:UmF*) | 2 | 1 | 50.0 | | | 1 | 50.0 | | | 1 | 50.0 | 1 | 50.0 |
| Unadjusted moved to good adjustment (*UvG:UmG*) | 8 | 7 | 87.5 | 1 | 12.5 | | | 4 | 50.0 | 4 | 50.0 | | |
| Unadjusted moved to excellent adjustment (*UvE:UmE*) | 4 | 4 | 100.0 | | | | | 3 | 75.0 | 1 | 25.0 | | |
| Satisfactory adjustment (*S*) | 4 | 3 | 75.0 | 1 | 25.0 | | | 2 | 50.0 | 2 | 50.0 | | |

one-third (15, or 33.3 per cent) moved to Good acceptance of children. Good acceptance of parents, however, was achieved by only two (13.3 per cent).

Where teachers who were unadjusted in the beginning moved to Good adjustment by the end of the experimental periods, the picture was different.

TABLE 6

RELATION OF MOVEMENT IN OWN ADJUSTMENT TO ACCEPTANCE
(Groups One and Two Combined: 65 Subjects)

| Pers. adj. | Sub-jects | Acceptance of children | | | | | | Acceptance of adults | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Good | | Medium | | Poor | | Good | | Medum | | Poor | |
| | *N* | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % |
| Unadjusted, no movement (*UvO:UmO*) | 7 | | | 1 | 14.0 | 6 | 86.0 | | | 1 | 14.0 | 6 | 86.0 |
| Unadjusted moved to fair adjustment (*UvF:UmF*) | 15 | 5 | 33.3 | 5 | 33.3 | 5 | 33.4 | 2 | 13.3 | 3 | 20.0 | 10 | 66.7 |
| Unadjusted moved to good adjustment (*UvG:UmG*) | 14 | 11 | 78.5 | 1 | 7.0 | 2 | 14.5 | 7 | 50.0 | 5 | 35.5 | 2 | 14.5 |
| Unadjusted moved to excellent adjustment (*UvE:UmE*) | 14 | 13 | 93.0 | 1 | 7.0 | | | 12 | 85.8 | 2 | 14.3 | | |
| Satisfactory adjustment (*S*) | 15 | 9 | 60.0 | 5 | 33.0 | 1 | 7.0 | 7 | 46.0 | 7 | 46.0 | 1 | 8.0 |

In Group 1 (Table 4), two-thirds of those showing such movement (4, or 66.7 per cent) moved also to Good acceptance of children, one-half (3, or 50 per cent) to Good acceptance of adults. In Group 2 (Table 5), 87.5 per cent (7 out of 8 persons) moved to Good acceptance of children, and again, 50 per cent (4 persons) to Good acceptance of adults.

As Excellent adjustment was achieved by subjects in both groups, acceptance increased even more. Out of the 14 persons moving from unadjustment to Excellent adjustment in the two groups combined (Table 6), 13 (or 93 per cent) moved also to Good acceptance of children; and 12 (or 85.8 per cent) to Good acceptance of adults.

When Critical Ratios were computed, and all degrees of movement were combined, there was an extremely significant difference between those who had moved and those who had failed to move in acceptance of both children and adults. The differences remained significant whether the movement achieved had progressed to Fair, Good, or Excellent in the acceptance of children. It remained significant also if progression was to Good or Excellent in the acceptance of adults.

In other words, *as movement in personal adjustment progressed, so also did movement in acceptance of children and, in general, also of adults.*

Meanwhile, what about those individuals who were satisfactorily adjusted at the beginning and who remained so throughout? There were 15 of these

in the two groups combined (Table 6). Of these, 9 (or 60 per cent) achieved Good acceptance of children; and 7 (or 46 per cent) achieved Good acceptance of adults. A smaller proportion had moved to Good acceptance in this group than in the group of those who had been unadjusted in the beginning and had moved to either Good or Excellent adjustment. Among those who had been unadjusted and had progressed and those who were satisfactorily adjusted, the differences in proportions were statistically fairly significant (Tables 7 and 8). The difference in acceptance in the group that had moved from unadjustment to Excellent adjustment alone was somewhat more significant.

In terms of ranking, the highest proportion of those who achieved Good acceptance of both children and adults were the teachers who had moved from unadjustment to Excellent personal adjustment. Those who had moved to Good adjustment were second; those who had been satisfactorily adjusted were third; those who had moved to Fair adjustment, fourth; and those who failed to move, last. The same ranking pertained in both the Teacher Training Institution Group and the Public School Group.

The close relation of movement in own adjustment to acceptance may of course in part be due to overlapping in the criteria by which they were both evaluated. Further exploration to examine the correlation between these attributes would no doubt be fruitful. In terms of the present study, however, *movement in the teachers' own personal adjustment bore far more important relationship to acceptance of children and of adults than did age or length of teaching or a degree of adjustment that was satisfactory to begin with.* In general, the more a teacher moved in her own personal adjustment, the more acceptant she became of children and adults. Where she was flexible enough to move in one way, she moved as well in the other. Where she was rigid and failed to move in one way, she failed as well in the other.

It also appeared that those who were more or less unadjusted in the beginning but who had the capacity to move ahead were in a more strategic position to accept children and adults than those who had been satisfactorily adjusted all along and who had not undergone the movement involved in readjustments within themselves. Possibly those who had gone through the process of readjustment, understood its value better and were better able to handle the process for others. Possibly, having known problems more intimately themselves, they were better able to identify with others who had problems, whereas those who had not experienced such problems could be less empathetic.

Whatever the interpretation, the finding is a hopeful one. In practical

TABLE 7

CRITICAL RATIOS OF VARIOUS ITEMS IN RELATION TO ACCEPTANCE OF CHILDREN

| Item *A* | Item *B* | Item A prevailing: Achieved good acc. of ch. *N* Subjects | $N_P$ | Prop *P* | Sigma $\sigma_P$ | Item B prevailing: Achieved good acc. of ch. *N* Subjects | $N_{P'}$ | Prop *P'* | Sigma $\sigma_{P'}$ | Diff. of proportions: Amount *Diff.* $P-P'$ | Sigma *Diff.* $\sigma_{P-P'}$ | Crit. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age under 30 | Age 30 or over | 53 | 31 | .586 | .0677 | 12 | 7 | .584 | .1420 | .002 | .1572 | .13 |
| Taught under 5 years | Taught 5 years or over | 10 | 8 | .80 | .1331 | 11 | 7 | .635 | .1452 | .165 | .1967 | .84 |
| Satisfactorily adjusted at beginning | Unadjusted at beginning | 17 | 11 | .647 | .1160 | 48 | 27 | .562 | .0717 | .085 | .1364 | .625 |
| Unadjusted at beginning: Showed movement | Unadjusted at beginning: No movement | 43 | 29 | .675 | .0714 | 7 | 0 | 0 | 0 | .675 | .0714 | 9.50 |
| Unadjusted at beginning: Moved to *F* | Unadjusted at beginning: No movement | 15 | 5 | .333 | .1216 | 7 | 0 | 0 | 0 | .333 | .1216 | 2.72 |
| Unadjusted at beginning: Moved to *G* | Unadjusted at beginning: No movement | 14 | 11 | .785 | .1096 | 7 | 0 | 0 | 0 | .785 | .1096 | 7.20 |
| Unadjusted at beginning: Moved to *E* | Unadjusted at beginning: No movement | 14 | 13 | .93 | .0850 | 7 | 0 | 0 | 0 | .93 | .0850 | 10.80 |
| Unadjusted at beginning: Moved to *G* or *E* | Satisfactorily adjusted | 28 | 24 | .858 | .070 | 15 | 9 | .60 | .1288 | .258 | .1466 | 1.77 |
| Unadjusted at beginning: Moved to *E* | Satisfactorily adjusted | 14 | 13 | .93 | .0850 | 15 | 9 | .60 | .1288 | .330 | .1546 | 2.13 |

TABLE 8

CRITICAL RATIOS OF VARIOUS ITEMS IN RELATION TO ACCEPTANCE OF ADULTS

| Item *A* | Item *B* | Item A prevailing: Achieved good acc. of adults — *N* Subjects | $N_P$ | Prop *P* | Sigma $\sigma_P$ | Item B prevailing: Achieved good acc. of adults — *N* Subjects | $N_{P'}$ | Prop *P'* | Sigma $\sigma_{P'}$ | Diff. of proportions: Amount *Diff.* *P-P'* | Sigma *Diff.* $\sigma_{P-P'}$ | Crit. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age under 30 | Age 30 or over | 43 | 26 | .49 | .0714 | 8 | 1 | .125 | .1361 | .157 | .2184 | .72 |
| Taught under 5 years | Taught 5 years or over | 10 | 5 | .50 | .1580 | 11 | 4 | .363 | .1452 | .137 | .2145 | .64 |
| Satisfactorily adjusted at beginning | Unadjusted at beginning | 17 | 9 | .53 | .1220 | 48 | 19 | .396 | .0706 | .134 | .1411 | .945 |
| Unadjusted at beginning: Showed movement | Unadjusted at beginning: No movement | 43 | 21 | .498 | .0761 | 7 | 0 | 0 | 0 | .498 | .0761 | 6.55 |
| Unadjusted at beginning: Moved to *F* | Unadjusted at beginning: No movement | 15 | 2 | .133 | .0875 | 7 | 0 | 0 | 0 | .133 | .0875 | 1.50 |
| Unadjusted at beginning: Moved to *G* | Unadjusted at beginning: No movement | 14 | 7 | .500 | .1332 | 7 | 0 | 0 | 0 | .500 | .1332 | 3.75 |
| Unadjusted at beginning: Moved to *E* | Unadjusted at beginning: No movement | 14 | 12 | .858 | .0934 | 7 | 0 | 0 | 0 | .858 | .0934 | 9.20 |
| Unadjusted at beginning: Moved to *G* or *E* | Satisfactorily adjusted | 28 | 19 | .679 | .0885 | 15 | 7 | .466 | .1290 | .213 | .1562 | 1.36 |
| Unadjusted at beginning: Moved to *E* | Satisfactorily adjusted | 14 | 12 | .858 | .0934 | 15 | 7 | .466 | .1290 | .392 | .1591 | 2.46 |

application, it points to the real educability of teachers. It may mean that we need not despair too greatly over the difficulty in finding the well adjusted personality all ready-made among those who apply for teaching positions. People can and do, with certain experiences move forward in their own adjustments. And as they do, they apparently can also find new insights and new understandings concerning the adjustment problems of those with whom they work.

## F. Summary and Conclusions

The present war has highlighted the incidence of psychiatric problems among the population. The evidence stands out in such facts as that 23 per cent of the rejections by the armed forces on induction are made for psychiatric reasons (7). The seriousness of the matter points to the need for prevention and reduction of such problems. This in turn calls for the training of persons who hold strategic positions in their relationships with others.

Such training becomes even more essential in view of the insufficient number of psychiatrists available to cover the field.

Teachers are in a strategic position to prevent and reduce mental hygiene problems. Far too seldom, however, do they possess insight into, or ability to accept, underlying emotions. In consequence, pressures in schools far too frequently contribute to frustrations and strain. The connection of the parent's emotional difficulties with the child's is far too seldom taken into account. The rôle of facing and accepting emotions and the value of emotional catharsis or release in reducing problems is either unknown or vigorously repudiated. Concepts widely recognized in psychiatrically oriented groups are not recognized. Procedures, therefore, must be experimented with which will help teachers to reorient themselves.

The present study goes into such procedures as they were utilized in training teachers in two different situations: (*a*) In a teacher training institution (Group 1) over a period of one year's time; (*b*) in a public school child-care situation (Group 2) over a period of four months.

Sixty-five subjects were included, 44 in Group 1; 21 in Group 2. Ages ranged from 19 to 52 years; previous teaching experience from zero to 17 years. Educational achievement ranged from college sophomore standing to completion of masters' degrees. Thirteen subjects were married, four divorced. Forty-eight were single.

Changes in the teachers' acceptance of children's and parents' emotional problems were coded as Good, Medium, or Poor. Changes in personal adjustment of those subjects who were observed to be unadjusted at the

beginning of the experimental periods were coded as Fair, Good, and Excellent. Adjustment of those subjects who were well adjusted throughout were designated as having had Satisfactory adjustment.

Movement in an individual teacher in the public school group is shown qualitatively in several ways: (*a*) In the case study of a child compiled by the teacher illustrating changes both in her attitudes and in her teaching techniques as the training period progressed. (*b*) In excerpts from conferences with a parent held by her, illustrating not only the shift in her acceptance of the parent, but also the concommitant changes in her counseling techniques. And (*c*) her own account of what happened to her and how she interpreted the changes that took place.

Movement in the two groups is quantitatively evaluated. At the beginning of the experimental periods, only three teachers manifested any degree of acceptance of either children or adults. By the end of the training period, Good acceptance of children was achieved by 52 per cent of the teachers in Group 1, and by 71.4 per cent in Group 2. Medium acceptance of children was achieved by 23 per cent in Group 1; by 14.3 per cent in Group 2. In Group 1, 25 per cent remained Poor in acceptance; in Group 2, 14.3 per cent.

In regard to their acceptance of adults, in Group 1, 43.3 per cent moved to Good acceptance; in Group 2, 43 per cent. In Group 1, 20.4 per cent moved to Medium acceptance; in Group 2, 33.3 per cent. In Group 1, 36.3 per cent remained Poor in acceptance of adults; in Group 2, 23.7 per cent.

Apparently it was more difficult to reach consistent, deep acceptance of adults than it was to reach similar acceptance of children. Apparently, too, it was possible to effect changes in a short term training period of four months, although the supervisory staff felt that, even though the ratings were not fine enough to show it, the changes in general assumed greater stability as result of the longer period.

Critical ratios were computed to show the relation of several concommitant factors to the teachers' movement in acceptance. These indicated that there was no significant difference in the ages of the teachers who moved ahead and the ones who failed to progress in acceptance of children. Apparently the older ones, over 30, contrary to what might be anticipated, were as able to change as the younger ones, under 30. Neither was there any significant difference in terms of the length of previous teaching. Those who had taught under five years were not, as might be expected, more open to change on the whole than were those who had taught longer. Nor was there any significant difference in the teachers who were more or less unad-

justed at the outset of the training period as compared with those who were satisfactorily adjusted. The one significant thing seemed to be the flexibility in contrast to the rigidity which the person displayed. When she moved ahead in her own adjustment, she also moved ahead in her acceptance of children and adults. Critical ratios of the difference in proportions of those who moved and those who failed to move ahead were extremely significant. Moreover, when the teacher experienced unadjustment problems of her own, she was apparently somewhat better able to understand and accept those of others. This was seen as those who were satisfactorily adjusted throughout the experimental periods were compared with those who moved from unadjusted to Good or Excellent personal adjustment during the time of training. Critical ratios here were fairly significant.

From the study, as a whole, it appeared that the procedures utilized were effective to an appreciable degree in helping teachers to become more acceptant of inner emotions. During the training periods many were able to move from a superficial, external viewpoint to one which focused on inner emotional content rather than on symptomatic behavior. They come to incorporate attitudes and practices which were preventive and reductive of mental hygiene problems.

## G. Suggestions for Further Work

In order to further the prevention of mental hygiene problems, similar types of procedure might be utilized more widely with various kinds of groups.

It would be interesting not only to take further groups from teacher training institutions, but also to attempt different kinds of in-service arrangements. For instance, taking the staff of an entire elementary school, and utilizing their own classrooms as laboratories.

Similar procedures might also be utilized in training clergymen, physicians, counselors in industry, shop-stewards in labor unions, to become more acceptant of the adults who normally bring problems to them. A particularly strategic group would be those pediatricians who have failed to gain psychiatric orientation in their medical preparation. Still another group of people needing such training are the parent education leaders. Their practices and procedures closely approximate those of teachers' in that they are prone to be repressive and external.

Another place where similar procedures may be carried on is with parents directly, helping them at one and the same time in their own adjustments and in becoming more acceptant of their children. Taking groups of preg-

nant mothers would be particularly effective in preventing problems, especially if their training could be carried through the first year of their children's lives.

Still another type of study along the lines of the present one, would be to utilize similar procedures, applying them to changing a variety of attitudes—as for instance, attitudes toward sex; or attitudes of discrimination toward minority groups.

Evaluation similar to that described in the present paper, or a more refined adaptation, kept during the training periods would help to evaluate what occurred. It would also help to revise procedures to better meet the needs of different types of groups so that increasingly effective results would be reached in achieving the desired outcomes, namely the prevention and reduction of mental hygiene problems.

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*226 South Gale Drive*
*Beverly Hills*
*California*

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# A STUDY OF THE "FEARS" OF RURAL CHILDREN*[1]

*Department of Psychology, Central Michigan College of Education*

KARL C. PRATT

## A. INTRODUCTION

The most extensive investigations of the fears of children are those which were undertaken by Jersild and his associates (1, 2). They utilize the techniques available for large-scale studies and illustrate the basic limitations or the unsolved and perhaps unsolvable elements of such problems.

The methods of study may be grouped into the subjective reports of individuals upon their affective experiences, and into the observations of the behavior of children either in situations as they normally arise in those deliberately produced. In the one, verbalizations of subjective "fears" are recorded. In the other, overt behavior is noted and classified according to some previously agreed-upon pattern or category. The first, or introspective, approach to the nature of things feared is featured either by the interviewing of children, or by the collection of adult memories of things feared in childhood. In the second, or objective, procedure observers report the occurrence and nature of overt behavior and describe the circumstances under which it appeared.

The principal sources of uncertainty in these and similar studies, including those reported in this paper, are obvious:

1. We do not know the relation between implicit and explicit responses, and hence can not infer one from the other.
2. We do not know that the subjective report of fears is inclusive or even crucially selective. One need not be a Freudian to accept the concept of repression or inhibition of fears.
3. We have no assurance that affectivity attaches to the object or thing reported.
4. We know nothing of the degree of emotionality of the alleged "fears."

Despite these limitations upon the interpretation of data from such re-

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[1]The data of this survey were presented in a paper read at the meeting of the Psychology Section of the Michigan Academy of Science, Arts, and Letters at Ann Arbor, March 17, 1944. The actual survey was made by rural teachers of Montcalm and Gladwin counties. The writer takes this opportunity to acknowledge their interest and aid in the project.

searches they are not without considerable value because they do reveal the presence of individual and cultural patterns of word associations. They illustrate the rôle of the physical and social environment in determining the nature, distribution, and stability of certain language patterns. The constellations of individual fears may also serve to indicate the need for child guidance and for mental hygiene, or perhaps to expose familial and social environments which are inimical to normal development.

## B. The Aims of the Survey

The present survey was undertaken to discover the nature and the variety of things of which rural children are afraid.

1. It seeks to ascertain what are the age and sex differences: (*a*) in the number of things feared; (*b*) in the variety of things feared; (*c*) in the relation of variability of fears to self-judgments of things most and things least feared, and the primacy and recency factors in the listing of fears; (*d*) in the categories of animal and non-animal fears; (*e*) in the fears having highest frequency.

2. It attempts to portray: (*a*) the extent of the impact of war upon word associations: (*b*) the evidence for specific as contrasted with general, cultural, verbal stereotypes of fears; (*c*) some individual patterns of fears which suggest a need for mental hygiene or for guidance.

## C. Survey Form, Methods, and Population

Five hundred seventy pupils (267 boys, 303 girls) ranging from 33 in the kindergarten or beginner's group to 88 in the 8th grade, with a median of 66 to the grade, responded to the survey. They ranged in age from 4 years to 15 years, 10 months.

Prior to the distribution of the survey sheets, teachers read the following directions aloud:

> Today we have a little exercise to write. When I pass the papers out, answer all the questions and do just what the paper tells you to do. Do not talk about this and do not look at each others papers. When you have finished, bring me the paper.

Children not sufficiently advanced in reading and writing to fill out the blank (Table *A*) were interviewed individually.

## D. Results

Table 1 presents the following picture of the total number of fears of rural children:

TABLE A

Name: .....
Age: Years ( ) Months ( )
Grade: Put a circle around the number of the grade you are in
K 1 2 3 4 5 6 7 8
Boy ( ); Girl ( )
Where do you live? Farm ( ) Village ( ) Small town ( ) City ( )
What is your mail address?
Town .....
R. F. D. .....
Street .....

Write down here all the things you are afraid of

If you need more lines to write things down on begin at top of the other column.

After you have finished writing down all the things you are afraid of:

Put a Box ☐ around each of the *three* things you are *most* afraid of.

Put a wavy line under each of the *three* things you are *least* afraid of.

TABLE 1
GRADE AND SEX DIFFERENCES IN TOTAL NUMBER OF FEARS

| | No. of children | Total fears | Median No. fears | Mean No. fears | *SD* | $SE_M$ | *CR* |
|---|---|---|---|---|---|---|---|
| K, 1, 2, 3, 4 Grades | 266 | 1892 | 6.3 | 7.1 | 3.9 | 0.24 | 2.28 |
| 5, 6, 7, 8 | 304 | 2400 | 6.5 | 7.9 | 4.6 | 0.26 | |
| Boys | 267 | 1824 | 6.2 | 6.8 | 3.8 | 0.23 | 4.00 |
| Sexes Girls | 303 | 2468 | 6.9 | 8.2 | 4.6 | 0.26 | |
| Totals | 570 | 4292 | | 7.5 | | | |

1. Five hundred seventy children list 4292 fears, or an average of 7.5 for each child.

2. The chances are about 98.8 in 100 that Grades 5, 6, 7, 8 have a reliably greater mean number of fears than have Grades K, 1, 2, 3, 4.

3. Girls list a greater mean number of fears than do boys, the difference being statistically significant.

TABLE 2

GRADE AND SEX DIFFERENCES IN THE NUMBER OF DIFFERENT FEARS

| | No. of children | % | Total fears | % | No. dif. fears | No. over-lap. | % | Tot./Dif. | (Dif./Tot.)100 | $CR$ $D_p$ |
|---|---|---|---|---|---|---|---|---|---|---|
| K, 1, 2, 3, 4 Grades | 266 | 47 | 1892 | 44 | 215 | 158 | 73 | 8.8 | 11.4 | 1.60 |
| 5, 6, 7, 8 | 304 | 53 | 2400 | 56 | 310 | | 51 | 7.7 | 12.9 | |
| Boys | 267 | 47 | 1824 | 42 | 259 | 162 | 63 | 7.0 | 14.2 | 3.20 |
| Sexes Girls | 303 | 53 | 2468 | 58 | 270 | | 60 | 9.1 | 10.9 | |
| Totals | 570 | | 4292 | | 367 | | | 11.7 | 8.6 | |

Legend: No. Overlap., number of different fears shared by the groups; Tot./Dif., number of fears for each different fear; (Dif./Tot.)100, percentage of total fears which are different; $CR$ $D_p$, critical ratio of the difference to the standard error of the difference in percentages.

Table 2 discloses that:

1. Of the total fears listed by the children, only 8.6 per cent are *different* fears. Or, in other words, there is an average frequency of 11.7 for each different fear. For each child the total number and the number of different fears are the same. But, as the number of children increases, fears will be shared and hence the increase in number of different fears will be only a fraction of the increase in the total number of fears.

2. The chances are about 94 in 100 that Grades 5, 6, 7, 8 have a reliably greater percentage of different fears than have Grades K, 1, 2, 3, 4.

3. In relation to their total fears boys have a reliably greater number of different fears than have girls.

According to Table 3, when children list six or more fears and render a judgment of the three things most and the three things least feared, there are:

1. Fewer different fears among the three *most* than among the three *least* feared ($CR = 1.9$, or about 97 chances in 100 that the difference is significant).

2. Fewer different fears among the *first* three listed than among the three *most* feared ($CR = 1.3$, or 90 chances in 100 that the difference is reliable).

3. Fewer different fears among the *first* than among the *last* three listed ($CR = 5.3$, or a statistically significant difference).

4. Fewer different fears among the three *least* feared than among the *last* three listed ($CR = 2.1$, or 98 chances in 100 that the difference is a true difference).

TABLE 3

THE THREE MOST AND THREE LEAST FEARED, AND THE FIRST THREE AND LAST THREE AMONG THE DIFFERENT FEARS

| | Total fears | *A* 3 Most Dif. fears | % | *CR* | *B* 3 Least Dif. fears | % | *CR* | *C* First 3 Dif. fears | % | *CR* | *D* Last 3 Dif. fears | % | *CR* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K, 1, 2, 3, 4 Grades | 390 | 78 | 20.0 | 1.1 | 102 | 26.2 | 0.5 | 66 | 16.9 | 1.2 | 123 | 31.5 | 0.9 |
| 5, 6, 7, 8 | 543 | 126 | 23.2 | | 150 | 27.6 | | 109 | 20.1 | | 181 | 33.3 | |
| Boys | 393 | 95 | 24.2 | 0.7 | 124 | 31.6 | 2.7 | 82 | 20.7 | 1.0 | 138 | 35.1 | 1.3 |
| Sexes Girls | 540 | 120 | 22.2 | | 128 | 23.7 | | 97 | 18.0 | | 168 | 31.1 | |
| Totals | 933 | 152 | 16.3 | | 183 | 19.6 | | 132 | 14.1 | | 220 | 23.6 | |

*CR*'s of the differences between percentages of the four categories of different fears

| | |
|---|---|
| *A* & *B* | 1.9 |
| *C* & *D* | 5.3 |
| *A* & *C* | 1.3 |
| *B* & *D* | 2.1 |

TABLE 4

FEARS OF ANIMALS AND NON-ANIMALS

| | Animals No. fears | % | *CR* $D_p$ | Non-animals No. fears | % | *CR* $D_p$ | Illegible items No. | % |
|---|---|---|---|---|---|---|---|---|
| K. 1, 2, 3, 4 Grades | 1522 | 80 | 6.9 | 336 | 18 | 6.2 | 34 | 2 |
| 5, 6, 7, 8 | 1701 | 71 | | 626 | 26 | | 73 | 3 |
| Boys | 1390 | 76 | 1.5 | 386 | 21 | 1.5 | 48 | 3 |
| Sexes Girls | 1833 | 74 | | 576 | 23 | | 59 | 2 |
| Totals | 3223 | 75 | | 962 | 22 | | 107 | 2 |

Legend: *CR* $D_p$, critical ratio of the difference to the standard error of the difference in percentages.

5. No statistically significant grade differences in the number of different fears correlated with list position or with self-judged degree of affectivity.

6. No statistically reliable sex differences, although boys have relatively more different fears among the three *least* feared than have the girls (*CR* = 2.7, or about 99.7 chances in 100 that the difference in percentages is significant).

In Table 4 it is noticeable that:

1. Out of 4292 fears listed, 3223, or 75 per cent, are of animals; 962, or

22 per cent, are of non-animals; and 107, or 2 per cent, are illegible items.

2. Grades K, 1, 2, 3, 4 have a significantly greater percentage of fears of animals than have Grades 5, 6, 7, 8; in fears of non-animals the grade relations are, of course, reversed.

Table 5 reveals the following in regard to the distribution of fears of animals among the *Vertebrates* and *Arthropods*:

TABLE 5
FEARS OF ANIMALS

| | No. fears | % | K, 1, 2, 3, 4 No. | % | 5, 6, 7, 8 No. | % | Boys No. | % | Girls No. | % |
|---|---|---|---|---|---|---|---|---|---|---|
| Vertebrata | 3068 | 95.0 | 1469 | 96.0 | 1599 | 94.0 | 1359 | 98.0 | 1709 | 93.0 |
| Reptilia | 414 | 13.0 | 194 | 13.0 | 220 | 13.0 | 171 | 12.0 | 243 | 13.0 |
| Aves | 107 | 3.0 | 60 | 4.0 | 47 | 3.0 | 37 | 3.0 | 70 | 4.0 |
| Wild | 43 | 1.0 | 23 | 2.0 | 20 | 1.0 | 17 | 1.0 | 26 | 1.0 |
| Domesticated | 64 | 2.0 | 37 | 2.0 | 27 | 2.0 | 20 | 1.0 | 44 | 2.0 |
| Mammalia | 2522 | 78.0 | 1202 | 79.0 | 1320 | 78.0 | 1138 | 82.0 | 1384 | 76.0 |
| Wild | 1506 | 47.0 | 744 | 49.0 | 762 | 45.0 | 697 | 50.0 | 809 | 44.0 |
| Domesticated | 744 | 23.0 | 357 | 23.0 | 387 | 23.0 | 318 | 23.0 | 426 | 23.0 |
| Man | 272 | 8.0 | 101 | 7.0 | 171 | 10.0 | 123 | 9.0 | 149 | 8.0 |
| Arthropoda | 144 | 4.0 | 49 | 3.0 | 95 | 6.0 | 26 | 2.0 | 118 | 6.0 |
| Crustacea | 20 | 0.6 | 5 | 0.3 | 15 | 1.0 | 4 | 0.3 | 16 | 0.9 |
| Insecta | 88 | 3.0 | 37 | 2.0 | 51 | 3.0 | 19 | 1.0 | 69 | 4.0 |
| Arachnoidea | 36 | 1.0 | 7 | 0.5 | 29 | 2.0 | 3 | 0.2 | 33 | 2.0 |
| Totals* | 3223 | | 1522 | | 1701 | | 1390 | | 1833 | |

Legend: *, includes forms not listed in table.

1. Of the 3223 fears of animals, 3068, or 95 per cent, are of *Vertebrates,* and 144, or 4 per cent, are of *Arthropods.*

2. Four hundred fourteen, or 13 per cent, are of *Reptiles* (snakes, alligators, turtles, crocodiles, and lizards).

3. One hundred seven, or 3 per cent, are of *Birds;* 43, or 1 per cent, Wild (hawks, eagles, etc.) and 64, or 2 per cent, Domesticated (roosters, turkeys, geese, and so on).

4. Two thousand five hundred twenty-two, or 78 per cent, are of *Mammals;* 1506, or 47 per cent, Wild; 744, or 23 per cent, Domesticated; and 272, or 8 per cent, are of *Man.*

5. Grades 5, 6, 7, 8 have a significantly greater percentage of fears of *Man* and *Arthropods* than have Grades K, 1, 2, 3, 4.

6. The chances are 99.4 in 100 that Grades K, 1, 2, 3, 4 are truly more afraid of *Vertebrates,* and 98.6 in 100 of Wild *Mammals* than are Grades 5, 6, 7, 8.

7. Boys have a significantly greater percentage of fears of Wild *Mammals,* whereas for girls the percentage is significantly greater for *Arthropods* (*Insects* and *Spiders*).

Table 6 shows that:

1. Of the 962 non-animal fears, 122, or 13 per cent, are of *fire;* 112, or 12 per cent, of natural phenomena such as *winds, storms, thunder* and

TABLE 6
NON-ANIMAL FEARS

| | No. fears | | K, 1, 2, 3, 4 | | 5, 6, 7, 8 | | Boys | | Girls | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | % | No. | % | No. | % | No. | % | No. | % |
| Fire | 122 | 13.0 | 44 | 13.0 | 78 | 12.0 | 53 | 14.0 | 69 | 12.0 |
| Storms, winds, thunder, lightning, earthquakes, etc. | 112 | 12.0 | 48 | 14.0 | 64 | 10.0 | 41 | 11.0 | 71 | 12.0 |
| Guns, bombs, spears, explosives, electricity, etc. | 103 | 11.0 | 48 | 14.0 | 55 | 9.0 | 42 | 11.0 | 61 | 11.0 |
| Cars, airplanes, trains | 93 | 10.0 | 43 | 13.0 | 50 | 8.0 | 44 | 11.0 | 49 | 9.0 |
| Dark, night, black-outs, etc. | 89 | 9.0 | 36 | 11.0 | 53 | 8.0 | 26 | 7.0 | 63 | 11.0 |
| Illness, diseases, doctors, dentists, | 78 | 8.0 | 4 | 1.0 | 74 | 12.0 | 21 | 5.0 | 57 | 10.0 |
| Water, swimming, diving, drowning | 69 | 7.0 | 17 | 5.0 | 52 | 8.0 | 25 | 6.0 | 44 | 8.0 |
| Ghosts, witches, spooks, dragons, Devil, skeletons, graveyards | 48 | 5.0 | 25 | 7.0 | 23 | 4.0 | 28 | 7.0 | 20 | 3.0 |
| War, fights, punishments, scoldings | 48 | 5.0 | 15 | 4.0 | 33 | 5.0 | 20 | 5.0 | 28 | 5.0 |
| High places, falling | 38 | 4.0 | 18 | 5.0 | 20 | 3.0 | 16 | 4.0 | 22 | 4.0 |
| School work (subjects, tests, passing) | 32 | 3.0 | 0 | 0.0 | 32 | 5.0 | 23 | 6.0 | 9 | 2.0 |
| Being alone, lost | 20 | 2.0 | 6 | 2.0 | 14 | 2.0 | 7 | 2.0 | 13 | 2.0 |
| Noises | 14 | 1.0 | 8 | 2.0 | 6 | 1.0 | 6 | 2.0 | 8 | 1.0 |
| Knives, sharp things, cutting | 14 | 1.0 | 2 | 1.0 | 12 | 2.0 | 5 | 1.0 | 9 | 2.0 |
| Dead people, death | 11 | 1.0 | 4 | 1.0 | 7 | 1.0 | 4 | 1.0 | 7 | 1.0 |
| Hot stoves, burns | 11 | 1.0 | 4 | 1.0 | 7 | 1.0 | 1 | 0.3 | 10 | 2.0 |
| Getting hit | 11 | 1.0 | 1 | 0.3 | 10 | 2.0 | 5 | 1.0 | 6 | 1.0 |
| Woods, jungles | 8 | 1.0 | 6 | 2.0 | 2 | 0.3 | 3 | 1.0 | 5 | 1.0 |
| Getting up before people, singing and saying pieces | 8 | 1.0 | 0 | 0.0 | 8 | 1.0 | 1 | 0.3 | 7 | 1.0 |
| Scary stories and movies | 7 | 1.0 | 0 | 0.0 | 7 | 1.0 | 3 | 1.0 | 4 | 1.0 |
| Totals* | 962 | | 336 | | 626 | | 386 | | 576 | |

Legend: *, includes some scattering non-animal fears not listed in table; %, to nearest whole number unless it is .5% or less.

*lightning;* 103, or 11 per cent, of *guns, bombs, explosives;* 93, or 10 per cent, of *cars, airplanes, trains;* 89, or 9 per cent, of the *dark* and *night;* 78, or 8 per cent, of *disease* and *illness;* 69, or 7 per cent, of *water* and *drowning;* 48, or 5 per cent, of *ghosts, witches, dragons, skeletons,* the *Devil,* etc.; and 48, or 5 per cent, of *war, punishment,* or other *human conflict.*

2. Grades 5, 6, 7, 8 have a significantly greater percentage of fears of *illness* and *disease,* and of *school work* (*subjects* and *passing*) than have Grades K, 1, 2, 3, 4 (the *CR*'s are, respectively, 7.8 and 5.6).

3. The chances in 100 that Grades K, 1, 2, 3, 4 are truly more afraid of the following than Grades 5, 6, 7, 8 are: *guns, bombs,* etc. (98.7); *cars, airplanes, trains* (99); *ghosts, spooks, witches,* etc. (97); *storms, thunder* and *lightning,* etc. (96); the *dark* and *night* (93); *high places* and *falling* (93). The chances are about 97 in 100 that Grades 5, 6, 7, 8 are reliably more afraid of *water* and *drowning.*

4. On a percentage basis boys have significantly more fears of *school work* (*subjects, tests* and *passing*) than have girls. And the chances are about 99.6 in 100 that they also have more fears of *ghosts, spooks, dragons,* etc.

TABLE 7

THE HIGHEST FREQUENCY FEARS AMONG BOYS

| K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| bears | bears | bears | bears | bears | snakes | bears | snakes | snakes |
| 14-14 | 16-9 | 19-10 | 23-10 | 18-10 | 17-8 | 24-8 | 19-8 | 16-7 |
| snakes | snakes | snakes | snakes | lions | bears | snakes | bears | bears |
| 10-10 | 16-9 | 16-9 | 19-8 | 15-8 | 16-8 | 18-6 | 17-7 | 12-5 |
| horses | bulls | lions | lions | snakes | dogs | bulls | bulls | lions |
| 6-6 | 10-6 | 12-7 | 17-8 | 12-7 | 12-6 | 14-5 | 10-4 | 10-4 |
| bulls | tigers | tigers | dogs | dogs | bulls | dogs | dogs | bulls |
| 5-5 | 10-6 | 11-6 | 14-6 | 10-6 | 11-5 | 14-5 | 10-4 | 9-4 |
| dogs | dogs | wildcats | bulls | tigers | lions | fire | lions | fire |
| 4-4 | 7-4 | 6-3 | 13-6 | 10-6 | 10-5 | 12-4 | 9-4 | 9-4 |
| cows | wolves | guns | wolves | bulls | tigers | lions | tigers | dogs |
| 4-4 | 7-4 | 6-3 | 9-4 | 9-5 | 9-4 | 12-4 | 9-4 | 8-4 |
| | | | tigers | | | | | persons |
| | | | 9-4 | | | | | 8-4 |
| Totals* | | | | | | | | |
| 100 | 171 | 183 | 225 | 177 | 207 | 306 | 232 | 223 |

Legend:

bears
14-14, the first number refers to the number of fears, the second to its percentage of the total number of fears;
Totals,* total number of fears of the sex and the grade.

TABLE 8
THE HIGHEST FREQUENCY FEARS AMONG GIRLS

| K | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| bears 8-11 | bears 18-8 | bears 10-8 | bears 23-9 | bears 34-9 | snakes 31-9 | snakes 28-7 | snakes 26-8 | snakes 31-8 |
| snakes 8-11 | snakes 14-7 | snakes 10-8 | snakes 16-7 | snakes 32-8 | dogs 20-6 | bears 24-6 | bulls 19-6 | dogs 17-5 |
| bulls 4-5 | bulls 11-5 | lions 7-6 | lions 15-6 | bulls 21-5 | bears 19-5 | dogs 24-6 | fire 14-4 | bears 16-4 |
| cats 4-5 | lions 11-5 | tigers 6-5 | tigers 14-6 | dogs 18-5 | bulls 17-5 | lions 19-5 | dogs 13-4 | dark 15-4 |
| dogs 3-4 | tigers 10-5 | wolves 6-5 | foxes 11-5 | lions 17-4 | lions 14-4 | tigers 17-5 | bears 12-4 | fire 13-3 |
| elephants 3-4 | dogs 9-4 | fire 5-4 | bulls 10-4 | horses 13-3 | tigers 11-3 | elephants 11-3 | tigers 11-3 | horses 9-2 |
| fire 3-4 | | | dogs 10-4 | | | wolves 11-3 | | bulls 9-2 |
| pigs 3-4 | | | | | | | | |
| Totals* 76 | 212 | 119 | 244 | 385 | 352 | 377 | 327 | 376 |

Legend: Same as in Table 7.

5. The chances are about 99.8 in 100 that girls have more fears of *illness* and *disease,* and 98.6 in 100 of the *dark* and *night,* than have boys.

Tables 7 and 8 list the highest frequency fears according to grade and sex. From them it may be seen that:

1. The six fears having highest frequency comprise from about 40 to about 27 per cent of the total fears of the Kindergarten through the 8th grade.

2. The three most common fears are of *bears, snakes* and *bulls;* closely following come *dogs, lions, tigers, fire, wolves, elephants,* and *horses.*

3. Up to and including Grade 4 *bears* are first in frequency, subsequently *snakes* become dominant. Fears of *persons* (*relatives* and *teachers*) among boys, and of the *dark* among girls, assume some importance in the 8th grade.

4. There are relatively few grade-to-grade differences in the fears having highest frequency.

5. There are few sex differences in the fears having highest frequency.

Table 9 reveals that Lion-Tiger and Lion-alone listings are about twice

TABLE 9

ORDER AND FREQUENCY OF LION-TIGER ASSOCIATIONS

| | Lion-alone | Tiger-alone | Lion-Tiger | Tiger-Lion |
|---|---|---|---|---|
| Boys | 35 | 12 | 38 | 15 |
| Girls | 21 | 17 | 44 | 26 |
| Totals | 56 | 29 | 82 | 41 |
| Totals | 85 | | 123 | |
| % | 66 | 34 | 67 | 33 |
| $SE_p$ | .04 | | .05 | |

Legend: $SE_p$, standard error of a percentage.

TABLE 10

FEARS RELATING TO WORLD WAR II

(Japs, Germans, war, Hitler, tanks, cannon, blackouts, air raids, Jap tanks and guns, machine guns, jeeps, torture, bombers full of Japs, Mussolini, poison gas, enemies.)

| | Total fears | War fears | % |
|---|---|---|---|
| Boys | 1824 | 52 | 2.8 |
| Girls | 2468 | 84 | 3.4 |
| Totals | 4292 | 136 | 3.2 |

as numerous as Tiger-Lion and Tiger-alone listings.

The number of fear associations centering upon World War II are given in Table 10:

1. About 3 per cent of the fear of boys and girls relate in some way to World War II.

2. Among the 136 such fears listed *Japs* have a frequency of 54, *Germans* 17, *Hitler* gets 10, whereas *Mussolini* rates only 1. *War* receives a frequency of 16.

The descriptive and modifying words by which children limit the range of fears within a given class are of great interest:

1. Children particularize or make specific their fears of domesticated animals (dogs, bulls, pigs, sheep, horses, cows, cats, roosters and so on) through the following modifiers: *our, some, strange, big, wild, angry, mean, ugly, cross, bad, fierce.*

2. Dogs and pigs are further particularized by *biting;* the former also by *bull* and *police;* the latter by *boar* or *old sow.* Cat is modified by *scratching.*

3. Horses are further modified by *kicking, running* and *runaway;* cows by *with horns* and *kicking;* sheep are made more specific by *bull, buck* and *ram.*

4. These modifications, and others even more restrictive, of domesticated

animals contrast strikingly with the fears of wild animals which, almost without exception, remain unparticularized or unmodified.

Individual groups of fears which possibly indicate a need for mental hygiene or other social intervention are illustrated by the following cases which are presented in the actual words and orthography of the children:

Kindergarten—Girl; 5 yrs. 9 mos.: I'm scared of Pa when he's been drinking. Scared of Ma when she's mad. I'm afraid of worms getting in my belly.

3rd Grade—Boy: I am afraid of truth. I am afraid of lying. I'm afraid of going to town. I'm afraid of going to the store. I'm afraid of going after the mail. I'm afraid of being good.

3rd Grade—Girl; 8 yrs., 7 mos.: Bear wolf, goast, wild cat, Dad, Grandpa, Uncle, Grandma.

6th Grade—Boy; 13 yrs., 4 mos.: I am afraid of not passing. I'm afraid of bairs. I'm afraid of rattlesnakes. I'm afraid of not passing in music. I'm afraid of bulldogs. I'm afraid of guns. I can't possibly get over being afraid of wemen and I afraid if I have to sing or say a peas in frunt of a lot of people alone.

6th Grade—Girl; 11 yrs., 5 mos.: Lockjaw, pneumonia, blood poison, scarlet fever, pink eye, tuberculosis.

7th Grade—Girl; 13 yrs., 3 mos.: Afraid of shadows in the dark behind things; afraid of fires; afraid of speed boats when fishing; afraid of mad dogs; afraid behind a horse; afraid to start in new school; afraid to go into strange houses; afraid to ride bicycle on a strange road.

7th Grade—Girl; 12 yrs., 3 mos.: A moose, a tigger; a bear, a rattlesnake; a lion; a boiling kettle of water; a man with a big knife; to go in a fiery barn; to sit on pins; an ugly bull.

8th Grade—Boy; 14 yrs., 9 mos.: Dark; stories after dark; to climb to high; some people; big fires; to see people who are hurt; shows where killing is taking place; people who are out of their head.

8th Grade—Girl; 12 yrs., 9 mos.: Of a snake; alone at night; in the dark; to be in a blizzard; to sing a song alone; to talk before lots of people; walk down a road at night; to sit with a boy; to kiss a boy.

## E. Discussion

It should be apparent from the introductory paragraphs of this article that the writer is not prepared to vouch for the affectivity of the "fears" tabulated during the course of this investigation. The term *fear,* in this study, should be regarded as a lexical category under which the verbal associations, evoked by the specific directions of the survey, may be grouped.

The researches upon newborn infants, reviewed by Pratt (3), give substance to the growing disposition of psychologists to relegate the term *emotion* to the same discard as *will* and other outmoded psychological concepts. The

behavioral development of young infants offers little support for the currently popular theory that development of the emotions is an educational objective. Similarly, the inventories of childhood fears fail to demonstrate any pressing need for extension of the range or increase in the number of such fears. Nor do they demonstrate that the intensity or degree of affectivity should be enhanced. In short, it is a rash person who would seriously advocate the development of more and greater fears.

The work of Jersild and his collaborators (1, 2), and the data of the present survey, reveal a mass of "fear" associations which are irrational and unrealistic in relation to the physical environments in which children live. Fears judged to be rational, in the sense that they apply to actual and present hazards such as cross *bulls, dogs,* and so on, are none the less negative and relatively generalized responses to situations. The true educational objective is the antithesis of an increase in emotionality. The aim is to develop a knowledge of things and situations which will give foresght and therefore avoidance of truly dangerous situations, and which will also provide specific modes of behavior adequate to those situations not foreseen or avoidable.

The degree of stability in the number and in the variety of childhood fears is not known because the methods of inquiry and of analysis of data have varied. In 1938, in an investigation which did not employ standard data sheets nor require judgment of a specific number of fears, the writer obtained an average of 4.9 fears for each child. In the present research the average is 7.5. This difference probably comes from a variation in survey form or method rather than from any change in the inhibition or expression of fears during these years.

There is no doubt of the fears having highest frequency in this region. Some of these, such as *bears* and *snakes,* probably represent a persistent cultural climate whereas others, such as *bulls* and *fire,* are the product of actual and potent stimuli within the physical rural environment.

The age differentials in the number and variety of fears are not statistically reliable but the greater average number in the upper grades, if substantiated by further studies, may be the outcome of greater linguistic facility or it may indeed represent a spread of affectivity as the experience of the child widens and deepens with increase in age. A linguistic precocity or some other sex difference, either basic or culturally imposed, may also account for the greater average number of fears of girls.

When self-judgments of affectivity are made, and six or more fears are listed, there is less variability among the fears listed *first* than among those *most* feared. There is also more variability among those listed *last* than

among those *least* feared. Hence the degree of affectivity, as self-judged, can not be the most potent factor determining which associations shall appear *first* and which shall come *last*.

It is difficult to make comparisons between fears of rural children and the fears of city children, as reported by Jersild, Markey, and Jersild (1), because the fundamental analyses differ in the two researches. In studying the fears of urban children the investigators set up certain categories of fears and then

> "only one credit was given to items of a particular class. If, for example, a child mentioned many particular animals, such as tigers, wolves, bears, lions, cobras, etc., only one tally was entered for the entire list. No matter how many animals were mentioned his response was scored only once under the heading of 'animals'" (p. 145).

Obviously, this procedure will simply give a picture of the number of children who register any response within a category. It will provide a frequency table of children distributed over the categories of fears but it will not establish the actual dominance or subordination of any specific fear or any particular category of fears among the total fears because one representative within a category is given the same weight as several items.

Failure to distinguish between children reporting fears within categories and actual numerical representation of specific fears within each category leads to confusion, as is shown by the following quotations:

> "When the number 101 appears after the heading 'animals' in the list below it means that 101 different children mentioned fears in this class. The number would be several times larger if each specific animal mentioned by each of the children were separately counted and added" (p. 145).
>
> "The largest single class of fears shown in Table XVIII consists of fears of the occult, of the supernatural, of mystery, skeletons, corpses and death. Twenty-one and one-tenth per cent of the fears first named (19.2 per cent of all fears mentioned) fall in this category. Fear of animals (17.8 per cent)" (p. 152).

Clearly the transition from *different children mentioning fears in a class* to *21.1 per cent of the fears first named* (*19.2 per cent of all fears mentioned*) is unwarranted and misleading.

One hundred one out of 398 urban children, or about 25 per cent, reported fears of animals. No directly comparable value for the rural children is available but a rough approximation may be made by taking the frequency for *bears*, which is 323, and letting that represent the number of children reporting in the category of animal fears. There are 570 rural children in-

volved in the survey. Hence about 57 per cent are reported as having this class of fears. Obviously not all children listed *bears* among their animal fears so that the actual percentage of the children having fears of animals must be still greater. Nevertheless the known representation demonstrates that a greater percentage of rural than of urban children are afraid of animals.

Moreover, of the actual fears listed by rural children, at least 75 per cent are of animals, *Man* included, and about 69 per cent, if *Man* is excluded. Rural children probably have more contact with animals but the preponderance of fears of wild animals, which are either not found in the region or which present no real hazard, is indicative of the cultural origin of such fears. From this it follows that these fears are stereotyped and unrealistic.

Urban and rural children also diverge in their non-animal fears, 19.2 per cent of the city children being afraid of the occult, the supernatural, death and dead people, and so on. Combining *all* frequencies in these classes, even though some children have listed more than one fear within the general category, gives a 12 per cent representation of rural children. Therefore a greater percentage of city than of rural children have been verbally influenced by such matters. Less than two per cent of the total fears of rural children fall into this category.

Similarly, 15 per cent of the urban children were afraid of criminals and bad characters, whereas by rough and necessarily exaggerated approximation only 9 per cent of rural children have such fears .

A striking illustration of cultural stereotyping is afforded by the almost two-to-one dominance of Lion-alone and Lion-Tiger as compared with Tiger-alone and Tiger-Lion listings.

From this survey it is apparent that World War II has had little effect upon the verbal associations of rural children in Central Michigan—not one of the basic stereotypes discovered in the 1938 investigation has been replaced by an association derived from the present conflict. Despite the daily barrage of news and propaganda in the press, the radio and the cinema, only about 3 per cent of the total fears of these children relate to the war. From one point of view this may be deplored as the failure of domestic propaganda to penetrate the region or to be markedly effective. From another, it is perhaps just as well that childhood be spared any lasting residue of vicarious horror.

## F. Summary and Conclusions

### 1. *The Number and Variety of Fears of Rural Children*

*a.* The number of fears expressed may depend upon the elicitation procedure employed.

*b.* Girls have more fears than do boys.

*c.* There is some evidence that the number of things feared increases with advance in age.

*d.* In relation to their total fears boys have more *different* fears.

### 2. *Variability and Self-Judgment of Affectivity in the Listing of Fears*

*a.* There are fewer different fears among the *first* than among the *last* items of lists of fears.

*b. Primacy* in the lists probably involves fewer different fears than things judged to be *most* feared.

*c.* Things judged to be *least* feared are probably less variable than those things which are placed *last* in the lists of fears.

*d.* The results seem to imply that degree of affectivity, as self-judged, is not the exclusive factor in determining the order of fear associations.

### 3. *Fears of Animals*

*a.* Fears of animals are dominant among rural children but decrease with age.

*b. Vertebrates* account for 95 per cent and *Arthropods* for 4 per cent of the fears of animals.

*c.* Wild *Mammals* dominate the domesticated in the number of fears.

*d.* Fears of *Man* and *Arthropods* increase with age.

*e.* Boys are relatively more afraid of Wild *Mammals,* girls of *Insects* and *Spiders.*

### 4. *Fears of Non-Animals*

*a.* Non-animal fears are less pronounced among rural children but do increase with age.

*b. Fire,* natural phenomena such as *storms, engines of destruction* and of *transportation,* and *darkness* stand out among the non-animal fears.

*c.* Fears of *illness, disease, dentists,* and *doctors* increase with age.

*d. School work* troubles boys (verbally at least) more than it does girls, and probably the younger boys are more impressed by references to the *supernatural.*

*e.* It seems quite likely that girls are more concerned about *illness* and *disease,* and probably with *darkness* and the *night,* than are boys.

### 5. *Cultural Stereotypes of Fears*

*a.* The dominance of fear of *bears* and certain other animals, such as *lions* and *tigers,* demonstrates the cultural rather than the individual and specific origin of many fears.

*b.* This is also well-illustrated by the frequency and position of *lion* in *lion* and/or *tiger* associations.

### 6. *Criteria of Specific, Individual Fears*

*a.* The application of limiting modifiers: our, some, strange, mean, ugly, etc., probably are in most instances evidence of actual contact or of specific discrimination.

*b.* These specific limitations are applied to domestic live stock or pets, almost never to other animal forms.

### 7. *The War and Fears of Rural Children*

*a.* The war has had comparatively little effect upon the fears of rural children.

*b.* The Japanese are more widely feared than the Germans.

### 8. *General Characteristics of the Fears Listed*

*a.* Objectively, the fears recorded in this investigation are the verbal associations evoked by the survey sheet's request to "write down here all the things you are afraid of."

*b.* Many of these are cultural stereotypes devoid of any real affectivity.

*c.* Some of the fears are particularized and have an emotional connotation.

*d.* Some of the associations reveal an unfavorable environment or inadequate adjustment.

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*Central Michigan College of Education*
*Mount Pleasant, Michigan*

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# INFLUENCE OF PARENTAL ATTITUDES ON CHILDREN'S PERSONAL INVENTORY SCORES*

*Murray State Teachers College, Murray, Kentucky*

WM. DRAYTON LEWIS

Parental attitudes are probably one of the most important factors in the emotional adjustment of the child. It is admittedly difficult to get an adequate measure of either the child's emotional adjustment or of parental attitudes, and a study which attempts to establish possible relationships between the two is certain to involve inevitable weaknesses that will make it almost impossible to arrive at more than the most general conclusions. This study has as its purpose the investigation of possible influences of parental attitudes, as determined by teachers' ratings, on scores which children make on a personal inventory, in this case, the *BPC Personal Inventory*. Specifically, this is a study of scores made on a personal inventory by three groups of children. The three groups of children are those whose parents were rated as manifesting a superior, average, or inferior attitude toward the child and the home.

Coördinated Studies in Education, Incorporated, conducted an extensive survey of elementary school children. More than fifty thousand school children in Grades 4 through 9 were included in this study. These children were in 455 schools, in 310 communities, in 36 states. The present study includes only Grades 5, 6, 7, and 9. Grade 4 was not used because the language of the Inventory appears to be too difficult for children at that level. Grade 8 is not available to the writer.

The children were all given the *BFC Personal Inventory*. The teachers were given the following instructions:

> In evaluating the home background, rate economic status as Superior, Average, or Inferior. Do the same in rating parental attitudes. Record these ratings as *S*, *A*, or *I*. For the country at large the ratings should be: *S* 25 per cent; *A* 50 per cent; and *I* 25 per cent. In this, as elsewhere, if there is not enough information available or obtainable to justify a rating, leave the space blank.

The teachers were asked to rate the "Parental attitudes toward child and home." It is unfortunate, we believe, that no clear definition was presented of what was meant by an "inferior" or "superior" parental attitude. This

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would probably have some effect upon the study by way of making for a lack of uniformity in the ratings. Another difficulty with these ratings is that they merely ask for parental attitudes in general. This would seem to imply a composite rating, that is, a rating that attempted to average the attitudes of the two parents. The child's emotional adjustment is apt to be quite differently affected by various situations relative to parental attitudes. The attitudes of both parents might be superior or inferior. On the other hand, the attitude of the mother might be satisfactory, and that of the father unsatisfactory, or vice versa, and the two situations might have very different effects on the child's adjustment. These possible situations would probably militate against any very high degree of relationship between the factors under consideration in this study. It is also true that if significant differences are found in the personal inventory scores of the children in the three groups then the significance of the differences will be enhanced, we believe, since factors which have just been mentioned, and others which will be mentioned later, would probably tend to minimize the differences between inventory scores obtained by children in the various groups which are determined by the teachers' ratings of parental attitudes.

Several additional observations need to be made relative to these ratings of parental attitudes toward the child and the home. The teachers did not distribute the ratings 25-50-25, as suggested. Rather, they showed a tendency to rate a high percentage as average, and a reluctance to rate parental attitudes as inferior. A relatively large sampling was made of the teachers' ratings and it was found that the attitudes of the parents of boys were rated: 14.9 per cent "inferior," 65.4 per cent "average," and 19.7 per cent "superior." For the parents of the girls the distribution was "inferior" 14.7 per cent, "average" 62.3 per cent, "superior" 22.8 per cent. It is obvious that the teachers' knowledge of parental attitudes would be quite meager in many cases and it is not to be expected, in view of the instructions, that ratings would be made of all parents. No check was made of the percentage of parents that were rated, but many were not rated. The writer believes that slightly over 60 per cent is a fair estimate of the number of parents rated. It is impossible to tell what error, if any, this might have introduced into the study.

The writer recognizes that personal inventories are not highly reliable instruments for individual diagnosis, but they do seem to provide fairly satisfactory instruments for group study by way of showing group trends. Teachers' ratings of parental attitudes are certain to be highly subjective and inaccurate at times. The fact that such a high percentage of the parental

attitudes are rated "average" would appear to indicate a tendency on the part of the teachers to give average ratings, probably due to a lack of definite knowledge of the parental attitudes and, consequent hesitation on the part of the teacher to rate the parent's attitude either "inferior" or "superior" in a given case. It should be noted, again, that the teachers did not rate parental attitudes in many cases where they did not have sufficient knowledge of parental attitudes. This, it would appear, would tend to make the study more reliable. The writer believes that the data included in this study give reliable enough trends to warrant the presentation of the data, even though the Inventory is not wholly diagnostic and though the teachers' ratings are subjective.

A total of 9,507 ratings of parental attitudes were available in cases where *BPC Personal Inventory* scores were also available. The sex distribution is 4,788 boys and 4,719 girls. An examination of the data presented in the tables will show that the boys appear in a more unfavorable light than the girls. The attitudes of parents of boys are rated lower than the attitudes of the parents of girls indicating, it would appear, that there is more friction between child, parent, and teacher in the case of boys than in the case of girls. The median scores on the Inventory are higher for the boys than for the girls. Low scores on this Inventory are considered the more desirable scores.

The distribution given in Table 1 shows that in the case of each group,

TABLE 1

DISTRIBUTION OF SCORES MADE ON *BPC Personal Inventory* BY CHILDREN THE ATTITUDE OF WHOSE PARENTS TOWARD CHILD AND HOME WERE RATED INFERIOR, AVERAGE, AND SUPERIOR, BY SEX: GIVING MEDIAN AND QUARTILE DEVIATION

| Test scores | Boys | | | Girls | | |
|---|---|---|---|---|---|---|
| | Inferior | Average | Superior | Inferior | Average | Superior |
| 0- 9 | 4 | 74 | 36 | 5 | 94 | 82 |
| 10- 19 | 61 | 340 | 183 | 52 | 424 | 280 |
| 20- 29 | 129 | 625 | 230 | 133 | 748 | 282 |
| 30- 39 | 158 | 685 | 205 | 156 | 644 | 236 |
| 40- 49 | 174 | 619 | 133 | 136 | 473 | 104 |
| 50- 59 | 133 | 371 | 69 | 106 | 312 | 44 |
| 60- 69 | 96 | 219 | 27 | 56 | 154 | 31 |
| 70- 79 | 36 | 83 | 11 | 32 | 76 | 6 |
| 80- 89 | 23 | 43 | 6 | 11 | 24 | 3 |
| 90- 99 | 4 | 6 | | 4 | 7 | 1 |
| 100-109 | 4 | 1 | | 2 | 1 | |
| Median | 43.39 | 37.21 | 30.00 | 40.11 | 33.30 | 26.11 |
| Total | 822 | 3,066 | 900 | 693 | 2,957 | 1,069 |
| *Q* | 26.07 ± 1.14 | 23.66 ± .53 | 21.45 ± .89 | 24.83 ± 1.18 | 23.54 ± .54 | 20.08 ± .77 |

that is, where the parental attitudes are rated "inferior," "average," or "superior," there is a distribution over practically the entire range of possible scores, indicating that there is by no means a complete identity between the teachers' ratings and personality inventory scores. This is to be expected in view of the diagnostic failure of the inventory in many instances. Another factor might well be one that has been mentioned previously, that is, that ratings are for the parents in general rather than for each parent. A teacher might be acquainted with only one parent and base the rating on that one parent only whereas the attitude of the other parent often might be quite different.

It is also true, it seems reasonable to assume, that parents whose attitudes are rated superior by the teachers might not be rated so by mental hygienists. Many parents who are rated as "good" parents by the adult world in general are anything but good parents from the point of view of a mental hygienist. They are over-possessive, domineering, allowing the child no self-determination or independence and, consequently, no freedom to grow in self-reliance and self-sufficiency. Insofar as teachers' knowledge of what constitutes "superior" or "inferior" parental attitudes is inadequate we would expect differences between their ratings and ratings which mental hygienists would give in similar cases. It must be remembered in this connection that all information available indicates that many teachers do not know what a mental hygienist means by a good or bad parental attitude.

The writer recognizes, then, that the teachers probably rated incorrectly the attitudes of many parents. Insofar as this is true we would not expect perfect agreement between personal inventory scores and teachers' ratings of parental attitudes, even granting that the personal inventory gave a correct diagnosis of the child's emotional adjustments, which they do not do in many cases, and granting that the parental attitude would always be reflected in the child's emotional adjustment, which might not always be the case. It is also recognized that parental attitudes are by no means the only factors involved in personal inventory scores so that we can expect to do no more than establish trends.

The medians for each group, as shown in Table 2, are higher for the children, the attitudes of whose parents are rated as "inferior" and lowest for those the attitudes of whose parents are rated as "superior." Low scores on this Inventory are the more desirable scores. The difference between the median scores of the "inferior" and "superior" groups is, in the case of the boys, 13.39, which is slightly more than one-half of the quartile deviation. For the girls, the difference is 14.00, which is greater than one-half of the

TABLE 2

A COMPARISON OF MEDIAN PERSONALITY TEST SCORES OF CHILDREN THE ATTITUDES OF WHOSE PARENTS TOWARD CHILD AND HOME WERE RATED INFERIOR, AVERAGE, SUPERIOR, BY GRADES, TOTAL GROUP, BY SEX

| Grade | Boys Inferior | Boys Average | Boys Superior | Girls Inferior | Girls Average | Girls Superior |
|---|---|---|---|---|---|---|
| 5 | 43.7 | 39.5 | 32.9 | 39.6 | 32.9 | 27.2 |
| 6 | 43.4 | 37.6 | 29.1 | 40.3 | 32.9 | 24.9 |
| 7 | 45.0 | 36.4 | 30.0 | 41.5 | 34.8 | 26.0 |
| 9 | 40.3 | 33.1 | 29.9 | 38.5 | 32.8 | 26.4 |
| Total | 43.39 | 37.21 | 30.00 | 40.11 | 33.30 | 26.11 |

quartile deviation. All the differences between the medians for the three groups, as shown in Table 1, possess a high degree of statistical reliability, the critical ratios, using probable error of the difference, run from 4.9 to 9.2, for the boys, and from 5.25 to 9.9 for the girls, which means that the probabilities that the differences are true differences are in excess of 99 chances in 100. Table 2 presents a breakdown of the median scores by grades. The trends here are consistent, the differences being small and unreliable.

A score of 20 or less on the inventory indicates, in most instances, a high degree of emotional stability. Table 3 gives the percentage of each group making scores of 20 or less. More than three times as many boys in the "superior" group, as in the "inferior" group, obtained scores of 20 or less.

TABLE 3

A COMPARISON OF THE PERCENTAGE OF CHILDREN ATTAINING SCORES OF TWENTY OR LESS ON THE *BPC* PERSONAL INVENTORY THE ATTITUDES OF WHOSE PARENTS TOWARD CHILD AND HOME WERE RATED INFERIOR, AVERAGE OR SUPERIOR: BY GRADES, FOR THE TOTAL GROUP, BY SEX

| Ratings | Boys Grade 5 | 6 | 7 | 9 | Total | Girls Grade 5 | 6 | 7 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Inferior | 7.4 | 10.3 | 5.7 | 9.3 | 7.8 | 6.1 | 8.6 | 9.9 | 9.7 | 8.4 |
| Average | 11.3 | 13.3 | 12.3 | 19.3 | 13.5 | 17.3 | 18.2 | 17.0 | 17.6 | 17.5 |
| Superior | 22.7 | 25.0 | 27.5 | 21.9 | 24.4 | 31.7 | 36.7 | 34.4 | 33.0 | 33.9 |

The difference is even greater in the case of the girls. Slightly over four times as many "superior" as "inferior" girls obtained scores of 20 or less. The differences possess a high degree of statistical reliability, the critical ratios ranging from 7.2 to 15.0, for boys, and from 9.9 to 20.4 for girls, using probable error of the difference.

A score of 60 or more on this Inventory probably indicates some degree of maladjustment and such scores are considered undesirable. Table 4 presents a comparison of the percentage of each group that obtained scores of

TABLE 4

A COMPARISON OF THE PERCENTAGE OF CHILDREN ATTAINING SCORES OF SIXTY OR MORE ON THE *BPC Personal Inventory* THE ATTITUDES OF WHOSE PARENTS TOWARD HOME AND CHILD WERE RATED INFERIOR, AVERAGE, OR SUPERIOR: BY GRADES, FOR TOTAL GROUP, BY SEX

| | Boys Grade | | | | | Girls Grade | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ratings | 5 | 6 | 7 | 9 | Total | 5 | 6 | 7 | 9 | Total |
| Inferior | 21.2 | 19.8 | 23.6 | 11.5 | 19.8 | 14.6 | 14.6 | 16.8 | 12.6 | 14.8 |
| Average | 12.8 | 12.0 | 13.4 | 7.2 | 11.4 | 9.5 | 7.8 | 10.7 | 7.4 | 8.8 |
| Superior | 7.0 | 5.4 | 3.5 | 2.9 | 4.9 | 3.9 | 2.6 | 4.8 | 4.2 | 3.8 |

60 or more. Slightly more than four times as many boys, and slightly less than four times as many girls, in the "inferior" group obtained scores of 60 or more than in the "superior" group. These differences are highly reliable statistically, the critical ratios range from 7.5 to 13.00, for the boys, and from 5.9 to 10.5, for the girls, using probable error of the difference.

It must be recognized that a study of this type can only show trends. Personal inventories, as has been pointed out above, cannot be depended upon to give an accurate diagnosis in individual cases, although they do appear to possess value in a group study such as this. It is also true that the teachers' ratings of the parents are subjective and probably incorrect in many cases. These factors, we believe, would tend to minimize differences so that differences when found, and this study does reveal significant differences, are evidently indicative of some relationship between the parental attitudes and the scores made by the children on the personal inventory.

A very definite trend is shown in this study. The children whose parents are rated by the teachers as having "superior" attitudes toward the child and the home do, as a group, obtain more desirable scores on the Personal Inventory than do those whose parents are rated as having "inferior" attitudes toward the child and the home. These differences possess a high degree of statistical reliability. It is quite evident that what the teachers, as a group, consider "inferior" and "superior" parental attitudes has a very definite effect, either directly or indirectly, on personal inventory scores obtained by children.

It is to be noted again, by way of caution, that many children made desirable scores on the inventory whose parents were rated as having "inferior" attitudes, whereas many children whose parents were rated as having "superior" attitudes obtained very undesirable scores on the inventory. It is obvious, then, that the correlation between personal inventory scores and teachers' ratings of parental attitudes is not sufficiently close to justify prediction in a specific case.

This study provides no basis for predicting that because a given child obtains an undesirable score on a personal inventory that the attitude of the parent must necessarily be unsatisfactory or that because a child obtains a score on the personal inventory indicating emotional adjustment that the parental attitude is necessarily desirable. It is possible that such may be the case but this study provides no support for such conclusions. This study gives only group trends and merely permits one to say that there is some definite relationship between personal inventory scores and parental attitudes as viewed by teachers. It would appear that these findings would justify the conclusion that one phase of the attack on the problem of the child's emotional adjustment must center on parental attitudes. It could not profitably be the only point of attack on the problem but it evidently is a vital point of attack.

It is true that this study does not point out any specific influence of parental attitudes toward child and home upon children's emotional adjustment as reflected in scores made on a personal inventory but it does indicate definitely that there is a relationship. This justifies the statement which was made above, we believe, that this study does emphasize an important point of attack upon the problem of children's emotional adjustment, that is, the attitude of the parent toward the child and the home.

*Department of Education*
*Murray State Teachers College*
*Murray, Kentucky*

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# AN ANALYSIS OF CHILDREN'S MAZE LEARNING, IN TERMS OF STAGES OF LEARNING*

*Institute of Child Welfare, University of California*

JOSEPH G. YOSHIOKA AND HAROLD E. JONES

In a previous article (1) the results of a stylus maze experiment with children were given in terms of group scores showing the differential errors made in different blinds, and the influence of procedure, pattern, and practice upon errors. The present report is concerned with data from the same experiment, analyzed with reference to time and error scores in successive stages of learning.

The subjects were 151 eighth grade pupils in an Oakland junior high school, an urban selection representing a fairly wide range of socio-economic status. Data on age and intelligence are given in Table 1.

TABLE 1
STATISTICAL CONSTANTS: *CA* AND *IQ*

| | | Chronological age | | *IQ* (Kuhlmann-Anderson) | |
|---|---|---|---|---|---|
| | *N* | Mean | *SD* | Mean | *SD* |
| Boys | 81 | 13.4 | .5 | 102.2 | 11.7 |
| Girls | 70 | 13.5 | .5 | 101.5 | 12.0 |

The construction of the maze was described in the preceding report. It may be briefly summarized as consisting of a checkerboard of square blocks mounted on a base in such a way as to provide four rows and six intersecting columns of slots through which a stylus could be moved from the starting point to the goal or exit at the opposite side of the maze. By the use of brass screws introduced from below, any alley could be converted into a cul-de-sac; entrances into blind alleys were electrically recorded. The subject was not required to wear a blindfold, since the open alleys could not be visually discriminated from the culs. Figure 1 indicates for each of two patterns the correct pathway (schematically shown by a heavy line) and the position of the blocking screws in the blind alleys (shown by black circles).

Seventy-five subjects learned Pattern 1 first and Pattern 2 next, while 76 learned the two patterns in the reverse order. Each group learned one pattern without supplementary signals (Procedure 1) and one pattern with either a buzzer or a light (Procedure 2 or 3) signalling the entrance into a

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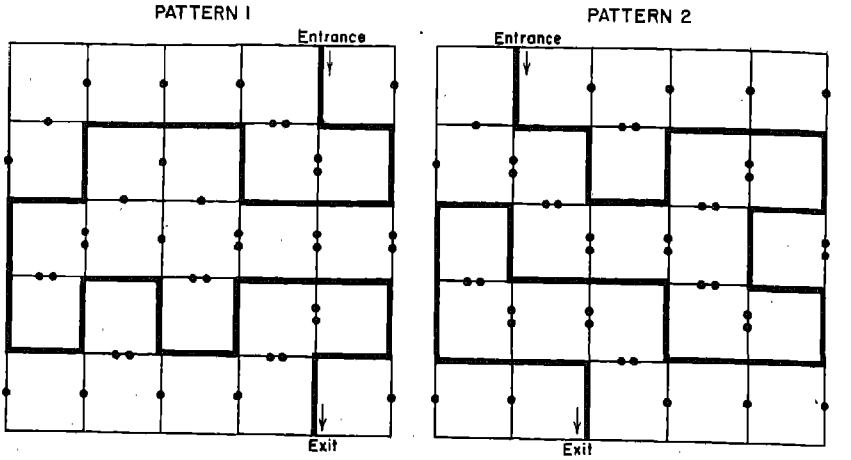


FIGURE 1
CORRECT PATHWAYS, FOR TWO STYLUS MAZE PATTERNS

blind. As was shown in the preceding article the buzzer and light signals were without effect upon the average performance; for the present purpose we have combined the data from the three procedures, keeping separate, however, the scores for the two patterns and the two orders. For convenience in description we shall refer to these subgroup scores in terms of the designations given in Table 2.

TABLE 2
EXPERIMENTAL SUBGROUPS

| N | Pattern | Order | Designation |
|---|---|---|---|
| 75 | 1 | 1 | 1-1 |
| 76 | 1 | 2 | 1-2 |
| 76 | 2 | 1 | 2-1 |
| 75 | 2 | 2 | 2-2 |

## SUBDIVISION OF TOTAL SCORES

In the administration of the tests, marked individual differences were apparent both in errors and time. The two variables were not, however, highly correlated. In the experimental situation no penalty was given to slow learners, and no premium to fast learners. The subjects were instructed to "go through" and learn the maze as rapidly as they could, but the specified criterion of learning was the ability to make two errorless trials in succession, regardless of time. Tolman and Nyswander (2) have

pointed out that in the usual maze situation time is a poor criterion of learning, some learners being exceptionally slow either because of lack of ability or because of their deliberate reactions. It may also be noted that exceptional speed is sometimes associated with a careless tendency to make frequent errors. The actual correlation between errors and time was found to range from .57 to .69, for the several subgroups.

In view of the considerations discussed above, it seemed desirable to compute learning scores not merely in terms of errors and time, but also in terms of errors-per-trial. This would serve to differentiate between individuals having the same total errors but with a differing form of learning curve. If, for example, *A* and *B* each have 40 total errors, but *A* concentrates these in five trials, while B scatters them through 10 trials, then *A*'s errors per trial would be 8 and *B*'s 4, indicative of the different rate of learning per trial. A more complete analysis can be obtained by computing errors-per-trial for successive stages of learning. This has been done by a modification of the Vincent method (3), with the stages classified as initial, middle, and final. The three arbitrary divisions of the learning process will be hereafter referred to as I, II, and III. The first trial was not included in Stage I, but was treated separately. The remaining trials were divided by three in order to obtain the three stages; when there was a remainder I and II were made equal at the expense of III. Thus 15 trials were divided into 5, 5, 5, but 11 trials were divided into 4, 4, 3. The summed errors in each stage were then converted into errors per trial so that a direct comparison could be made with the first trial.

For further qualitative differentiation, retracings and the total repeated errors in the same blinds were considered. These were, however, relatively few in number and it was judged unnecessary to subdivide them in relation to stages of learning. Lastly, the time scores were added in total as well as in all the subdivisions above mentioned, with the exception that time scores were not available for repeated errors and retracings. Tables 3 and 4 give the means and standard deviations for each subgroup, for each of the measures discussed above.

To present more clearly certain of the relationships in Tables 3 and 4, Tables 5 and 6 have been computed. Table 5 shows for the several groups a strikingly consistent picture with regard to the elimination of errors, and also with regard to the reduction in time, in the successive stages of learning. It may, however, be noted that in the case of each pattern the reduction from Trial 1 to Stage I is less rapid in the case of the second order than in the case of the first order. This is true of both errors and time. It is

TABLE 3
GROUP MEANS AND STANDARD DEVIATIONS—(ERRORS)

| Experimental subgroup | 1-1 Mean | *SD* | 1-2 Mean | *SD* | 2-1 Mean | *SD* | 2-2 Mean | *SD* |
|---|---|---|---|---|---|---|---|---|
| Total | 34.15±1.64 | 14.17 | 30.28±1.91 | 16.63 | 62.17±3.60 | 31.39 | 45.27±2.85 | 24.71 |
| Total per trial | 3.72±0.12 | 1.01 | 3.43±0.16 | 1.36 | 5.30±0.22 | 1.92 | 4.40±0.17 | 1.43 |
| First trial | 14.71±0.53 | 4.61 | 11.39±0.37 | 3.22 | 20.78±0.69 | 6.01 | 15.00±0.59 | 5.12 |
| I Initial stage (per trial) | 4.98±0.21 | 1.87 | 5.31±0.36 | 3.14 | 7.63±0.37 | 3.23 | 6.62±0.38 | 3.32 |
| II Middle stage (per trial) | 1.92±0.12 | 1.08 | 2.00±0.16 | 1.37 | 3.36±0.20 | 1.75 | 2.76±0.24 | 2.09 |
| III. Final stage (per trial) | 0.33±0.05 | 0.40 | 0.31±0.06 | 0.49 | 0.88±0.14 | 1.24 | 0.53±0.08 | 0.71 |
| Repeated errors | 3.96±0.05 | 5.60 | 2.18±0.50 | 4.35 | 15.87±1.90 | 16.54 | 8.92±1.33 | 11.55 |
| Retracings | 1.15±0.16 | 1.41 | 0.63±0.12 | 1.01 | 4.41±0.39 | 3.43 | 2.62±0.36 | 3.12 |

TABLE 4
GROUP MEANS AND STANDARD DEVIATIONS—(TIME IN SECONDS)

| Experimental subgroup | 1-1 Mean | *SD* | 1-2 Mean | *SD* | 2-1 Mean | *SD* | 2-2 Mean | *SD* |
|---|---|---|---|---|---|---|---|---|
| Total time | 243.87±11.18 | 96.78 | 209.75±7.88 | 68.70 | 353.25±16.71 | 145.69 | 287.36±13.68 | 118.51 |
| Total per trial | 26.42± 0.76 | 6.56 | 24.79±0.69 | 6.06 | 31.20± 1.24 | 10.80 | 28.57± 0.87 | 7.51 |
| First trial | 48.00± 2.19 | 19.00 | 39.41±1.24 | 10.80 | 66.97± 2.95 | 25.71 | 49.67± 2.08 | 18.05 |
| I Initial stage (per trial) | 29.33±1.07 | 9.27 | 30.92±1.35 | 11.73 | 35.83± 1.81 | 15.80 | 34.33± 1.29 | 11.27 |
| II Middle stage (per trial) | 23.64± 0.79 | 6.86 | 23.08±0.88 | 7.60 | 26.41± 1.57 | 13.73 | 26.13± 0.99 | 8.61 |
| III Final stage | 18.32± 0.61 | 5.28 | 17.66±0.74 | 6.45 | 20.22± 0.68 | 5.95 | 19.28± 0.64 | 5.51 |

TABLE 5

ERRORS PER TRIAL IN EACH STAGE OF LEARNING, AS A PERCENTAGE OF THE ERRORS IN THE FIRST TRIAL

| | 1-1 | 1-2 | 2-1 | 22 | Average |
|---|---|---|---|---|---|
| Trial 1 | 100 | 100 | 100 | 100 | 100 |
| Stage I | 33.85 | 46.62 | 36.72 | 44.13 | 40.33 |
| Stage II | 13.05 | 17.56 | 16.17 | 18.40 | 16.30 |
| Stage III | 2.24 | 2.72 | 4.23 | 3.53 | 3.18 |

TABLE 5*a*

TIME PER TRIAL IN EACH STAGE OF LEARNING, AS A PERCENTAGE OF THE TIME IN THE FIRST TRIAL

| | 1-1 | 1-2 | 2-1 | 22 | Average |
|---|---|---|---|---|---|
| Trial 1 | 100 | 100 | 100 | 100 | 100 |
| Stage I | 61.10 | 78.46 | 53.50 | 69.12 | 65.55 |
| Stage II | 49.25 | 58.56 | 39.44 | 52.61 | 49.97 |
| Stage III | 38.17 | 44.81 | 30.19 | 38.82 | 38.00 |

TABLE 6

COEFFICIENTS OF VARIATION

| | 1-1 | 1-2 | 2-1 | 2-2 | Average |
|---|---|---|---|---|---|
| | | *Errors* | | | |
| Total | 41.5 | 54.9 | 50.5 | 54.6 | 50.4 |
| Total per trial | 27.2 | 39.7 | 36.2 | 32.5 | 33.9 |
| First trial | 31.3 | 28.3 | 28.9 | 34.1 | 30.7 |
| I Initial stage | 37.6 | 59.1 | 42.3 | 50.2 | 47.3 |
| II Middle stage | 56.3 | 68.5 | 52.1 | 75.7 | 63.2 |
| III Final stage | 121.2 | 158.1 | 140.9 | 134.0 | 138.6 |
| Repeated errors | 141.4 | 199.5 | 104.2 | 129.5 | 143.7 |
| Retracings | 122.6 | 160.3 | 77.8 | 119.1 | 120.0 |
| | | *Time* | | | |
| Total | 39.7 | 32.8 | 41.2 | 41.2 | 38.7 |
| Total per trial | 24.8 | 24.5 | 34.6 | 26.3 | 27.6 |
| First trial | 39.6 | 27.4 | 38.4 | 36.3 | 35.4 |
| I Initial stage | 31.6 | 37.9 | 44.1 | 32.8 | 36.6 |
| II Middle stage | 29.0 | 32.9 | 52.0 | 33.0 | 36.7 |
| III Final stage | 28.8 | 36.5 | 29.4 | 28.6 | 30.8 |

another way of stating the fact that the initial trial is especially difficult in the first order of either pattern, and leads to the implication that transfer effects from one pattern to another apply primarily to the initial trial. A marked reduction also occurred in repeated errors, including those in the first trial.

Comparing the two halves of Table 5, it is readily seen that errors decrease more rapidly and to a relatively lower point than time scores. It takes time to make errors, but it also takes time to avoid errors, and to trace the

correct pathway. Hence although in the final third of the learning process the errors may be reduced to one-fiftieth of those made on the first trial, the traversal time may decrease to only about one-third. A difference in this direction (although perhaps not of this degree) is to be expected in view of the fact that error elimination and not speed per se, was the criterion of learning.

In Table 6 it can be seen that successive stages of learning produce a sharp increase in coefficients of variation for errors. This is due to the tendency of a few cases to pull away from the mean of the group, through persistent failure to eliminate common errors. The same tendency (stereotypy in errors) is also apparent in the measures for repeated errors, and to some extent in the retracings. The smallest relative variability occurs in the case of total-errors-per-trial. The greater stability of this measure is due to the fact that extreme cases (whether for errors or time) tend to be drawn in and the distributions become more compact when scores are corrected for trials made. Thus, an individual with an extremely high frequency of errors is likely to have this factor additionally weighted through a greater-than-average number of trials; in errors-per-trial he would therefore tend to fall closer to the mean of the group. In the case of time scores (as shown in the second half of Table 6), the relationship of the standard deviations to the means is more stable than in the case of errors, with a tendency for relative variabilities to decrease slightly rather than to increase. The influence of a few poor learners in the later stages of learning is not conspicuous because (as was shown in Table 5) the decrement in the time averages is smaller than in the error averages.

We are now prepared to consider the relationship of patterns and orders in terms of stages in learning. Table 7 presents, in the form of critical

TABLE 7
COMPARISON BETWEEN TWO ORDERS
(Critical Ratios)

| | Pattern 1 | | Pattern 2 | |
|---|---|---|---|---|
| | Errors | Time | Errors | Time |
| Total | 1.62 | 2.49 | 3.68 | 3.04 |
| Total per trial | 1.45 | 1.58 | 3.21 | 1.74 |
| First trial | 5.11 | 3.41 | 6.80 | 4.79 |
| I Initial stage (per trial) | —0.79* | —0.92 | 1.91 | 0.68 |
| II Middle stage (per trial) | —0.40 | 0.47 | 1.94 | 0.15 |
| III Final stage (per trial) | 0.28 | 0.69 | 2.13 | 1.01 |

*A negative number signifies that the second order produced more errors or longer time.

TABLE 8
COMPARISON BETWEEN TWO PATTERNS
(Critical Ratios)

| | Order 1 | | Order 2 | |
|---|---|---|---|---|
| | Errors | Time | Errors | Time |
| Total | 7.03 | 5.44 | 4.37 | 4.21 |
| Total per trial | 6.32 | 3.30 | 4.22 | 3.41 |
| First trial | 6.82 | 5.17 | 5.16 | 4.24 |
| I Initial stage (per trial) | 6.16 | 3.10 | 2.53 | 1.92 |
| II Middle stage (per trial) | 6.26 | 1.57 | 2.62 | 2.31 |
| III Fiinal stage (per trial) | 3.69 | 2.09 | 2.22 | 1.65 |

Positive numbers indicate that Pattern 2 produced more errors or longer time.

ratios, a comparison of the two orders on each pattern (Group 1-1 as compared with 1-2; 2-1 as compared with 2-2).

The critical ratios in nearly every case are positive (indicating greater difficulty of Order 1); the two orders, however, are most clearly different (with critical ratios consistently above 3) only in the case of the first trial. In other words, confirming a suggestion made earlier, the experience gained in learning another pattern has its maximum transfer effect, both with regard to time and errors, on the first trial of a new pattern. In the successive stages of learning (excluding the first trial) the additional transfer effect is small. On the first trial the greater magnitude of the critical ratios for errors than for time suggests that the transfer effect operates primarily through the development of a *more discriminating attitude toward performance* (e.g., inspection of the maze to estimate general direction of the probable true path).

Table 8 presents a comparison between the two patterns, for each order (Group 1-1 as compared with 2-1; 1-2 as compared with 2-2).

The greater difficulty of Pattern 2 is particularly apparent on the first order; it becomes reduced somewhat when transfer effects are operative. The difference in patterns is consistently greater on the first trial than on Stages I, II, and III, becoming reduced as the result of specific learning. It is also consistently greater for errors than for time, indicating that the difference between the patterns is attributable directly to the position and relationships of the blind alleys rather than to differences in the length of the true path or to factors producing emotional disturbance or "blockage" in performance. Similar conclusions were derived from the previous study of differential errors (1).

## Correlations between the Score of Two Patterns

As would be expected from previous work, the correlation of performance on two different patterns learned consecutively is not high. The correlation coefficient between the total error scores of Groups 1-1 and 2-2 (learning Pattern 1 first and Pattern 2 next) was .513, and that between scores of Groups 1-2 and 2-1 (learning Pattern 2 first and Pattern 1 next) was .458. We cannot correct these figures for attenuation, inasmuch as there is no measure available for the reliability of each pattern. A reliability coefficient based on odd-even blinds or odd-even trials would not be appropriate, since we cannot divide the patterns, or the trial records, into strictly comparable halves; moreover, in a learning test errors on consecutive blinds or consecutive trials are not independent, and a correlation between them would represent not merely the expression of an ability common to both but also the influence of errors arising accidentally in one blind or trial. Another type of reliability coefficient has been discussed in a previous article (1), in which it was found that the mean frequencies of entrance to each blind in each pattern by two comparable samplings (e.g., two groups which learned Pattern 1 first) was .953 for Pattern 1 and .966 for Pattern 2. This, however, pertains to the reliability of our measures of differential errors of the blinds, rather than to the reliability of our measures of total error scores for individual performers. Moderate or low correlations between two patterns may be regarded as determined not merely by specific factors in the patterns, but also by differential changes in the performers with respect to (*a*) adaptation to the maze situation (*b*) motivation.

Table 9 shows the correlations between two patterns in terms of both time and errors, for a number of different measures. These are all moderate

TABLE 9
Correlations between Two Patterns

| | *r*1-1,2-2 | | *r*1-2,2-1 | |
|---|---|---|---|---|
| | Errors | Time | Errors | Time |
| Total | .513 | .578 | .458 | .452 |
| Total per trial | .264 | .541 | .172 | .339 |
| First trial | .291 | .306 | .327 | .219 |
| I Initial stage (per trial) | .225 | .111 | .244 | .109 |
| II Middle stage (per trial) | .181 | .387 | .288 | .223 |
| III Final stage (per trial) | .443 | .412 | .585 | .413 |
| Repeated errors | .120 | — | .224 | — |
| Retracings | .212 | — | .198 | — |

or low. Correlations for time correspond fairly closely to those for errors. Correlations for total errors or time are higher than those for either of these measures per trial. This effect would be produced if individuals are fairly consistent in their efficiency of learning (in terms of gross errors) but inconsistent in their methods of learning. Thus on the first pattern a subject may work cautiously and obtain few errors per trial spread over many trials; in the next pattern he may tend to compact his errors into a few thoroughly exploratory trials; in such a case total errors (and time) could be in agreement on the two patterns, but with wide differences between the errors-per-trial or time-per-trial measures. Although this cannot be established as a statistically significant trend, it is worthy of note that the correlations between patterns appear to be higher on the final than on earlier stages of learning; this would be the case if the influence of chance factors becomes reduced in the later stages.

Studies of trial-and-error learning have thus far been of greater interest from the point of view of group results, than as a means of revealing individual traits of psychological significance. This restriction may, however, be due chiefly to the prevalent methods of treating the data. More analytic methods, as illustrated above, may serve not merely to emphasize the operation of individual differencees, but with a sufficient amount of experimental evidence, may also be serviceable in studying the nature of those individual factors which contribute to deviate performance.

Figure 2 illustrates variations in the components of learning for a series of cases selected as representing various types of performance. For each case two profiles are plotted, in standard scores,[1] showing performance on Pattern 1 (Order 1) and Pattern 2 (Order 2).

Case D16, in the upper left corner, illustrates, for total errors, an approximately average performance on each pattern. Minor fluctuations about the average occur in the various measures represented in the profile.

Cases C9 and E7, in the upper right corner, show contrasting levels of performance. Case C9 is fairly consistently superior in learning; Case E7 is inferior, particularly in the later stages of learning and in total errors. This individual was, incidentally, near the lower extreme of the group in *IQ*.

Case H1, in the lower left, illustrates for a given pattern fairly consistent performance, but with a marked improvement for the second as compared with the first pattern.

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[1]The standard scores are computed with the mean at 50 and an *SD* of 10. A score of 60, for example, represents a performance 1 *SD* above the mean (indicating fewer errors than the mean).

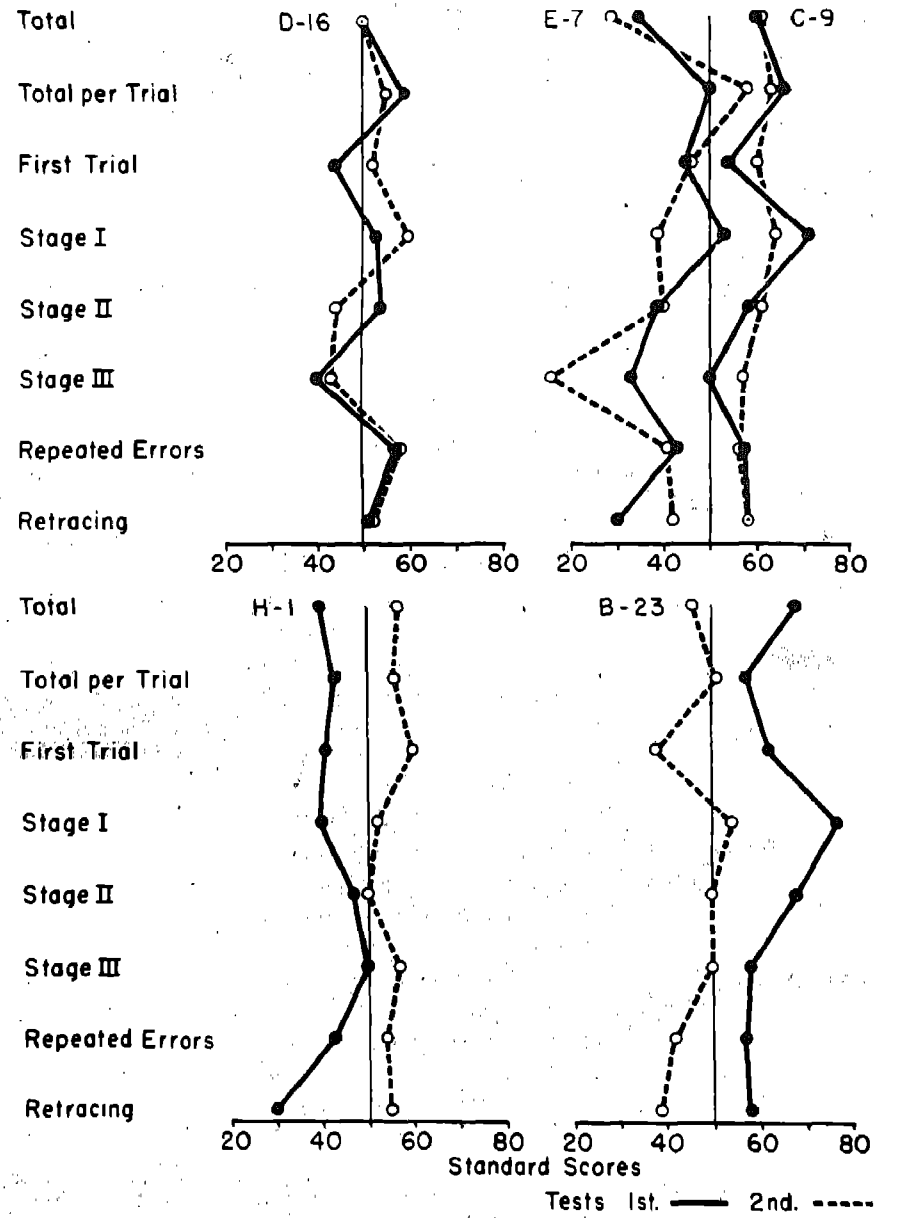


FIGURE 2

INDIVIDUAL PROFILES, BASED ON COMPONENTS OF LEARNING

Case B23, on the lower right, shows a superior record in the first pattern, with a decline to average or below average scores in the second pattern.

While many individuals reveal fairly consistent stages of learning, others show marked irregularity. To some extent this is a matter of chance fluctuation, and to some extent is attributable to the fact that numerous chance errors on the first trial may tend to a relatively improved record on subsequent trials, while relatively sudden success on the first may leave the subject still in need of considerable trial-and-error exploration. It is also probable that patterns of performance may represent individual characteristics and individual differences in learning which are not seen in the total scores alone. In view, however, of the low correlations for successive patterns, it is unnecessary to point out that tests would be required on a considerably larger number of patterns, if individual differences in these component factors are to be measured reliably.

## SUMMARY

1. One hundred fifty-one eighth grade pupils in a public junior high school were tested in a balanced order, on two patterns of a stylus maze.

2. The results for each pattern, in each order, were analyzed in terms of total errors and errors per trial and also in terms of component errors (repeated errors, retracings, errors in the first trial, and errors in each of three stages of learning.) A similar analysis was made for time scores.

3. In comparing orders, it was found that a transfer effect, from one pattern to the next, was manifested chiefly in performance on the first trial.

4. Relative to performance on the first trial, errors in successive stages of learning were found to decrease more rapidly than time scores.

5. In errors, but not in time scores, successive stages of learning resulted in a sharp increase in relative variability. This was interpreted as due to "stereotypy" in errors among poor learners.

6. Differentiation of patterns in terms of difficulty was more marked for errors than for time. Differentiation was reduced by transfer effects from one pattern to the next, and by specific learning within a given pattern.

7. Correlations of the order of .5 were found between performance scores on successive patterns; lack of closer correspondence was attributed to differential transfer effects as well as to motivational changes and chance factors.

8. For the successive stages of learning, correlations between patterns ranged from .11 to .24 for the first stage, and from .41 to .58 for the third stage.

9. Standard score charts were presented for a series of individual cases, illustrating contrasting profiles in the components of learning.

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*Institute of Child Welfare*
*University of California*
*2739 Bancroft Way*
*Berkeley, California*

# SHORT ARTICLES AND NOTES

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## NOTE ON WELLMAN'S RE-ANALYSIS OF *IQ* CHANGES OF ORPHANAGE PRESCHOOL CHILDREN

*Department of Psychology, Stanford University*

QUINN MCNEMAR

The final paragraph of the recent article by Wellman and Pegram (4, p. 263) reads as follows:

> The results of the re-analysis support the conclusions of the original monograph (*a*) that the control environment produced substantial losses in *IQ* when experienced for long periods, (*b*) that preschool education supplementing the control environment counteracted such losses, (*c*) that whether or not the preschool environment produced gains depended upon the amount and consistency of preschool attendance.

This reiteration implies that the criticisms (1, 2) of the original study (3) and of the review (5) of our critique (1) have somehow been surmounted by new statistical treatment of the data. The re-analysis uses two statistical techniques: analysis of variance and correlational analysis, neither of which have been utilized as effectively as is possible.

The analysis of variance technique has been used to test the significance of the differences between groups for initial *IQ*'s, then for final or terminal *IQ*'s. This procedure does not properly test the significance of net changes. Direct application of the analysis of variance to the individual changes yields ratios of *less* significance than those reported by Wellman and Pegram for various comparisons. The use of change scores does not, however, provide as sensitive nor as defensible a test as is available in the covariance method which permits (*a*) an analysis of final *IQ*'s adjusted for initial differences between groups and (*b*) greater precision by way of a reduced error term. By the covariance method we find, for instance, that the differences between the control, the 50 per cent or more preschool attendance, and the less than 50 per cent attendance groups, with residence of more than 400 days, are of *more* significance than judged by Wellman and Pegram. As a test of significance this method leads to just one variance ratio or *F* (*P circa* .005), whereas their method involves the comparison of two *F*'s which is equivocal without a test of the significance of the difference between *F*'s.

In their correlational analysis they use the indirect method of determining the correlation of a given variable with initial and with final scores, then conclude, if there is a significant difference between the two *r*'s, that the variable in question is related to *IQ* changes. Why not make a direct analysis by correlating the given variable with the changes from initial to final? Such a method not only permits a significance test, but also provides a measure of the strength of association between the given variable and the changes.

TABLE 1

CORRELATIONS WITH INITIAL AND FINAL *IQ*'S AS REPORTED BY WELLMAN AND PEGRAM, AND CORRELATIONS WITH CHANGES IN *IQ*, OUR COMPUTATION

| Variable | Group | *N* | With initial *IQ* | With final[1] *IQ* | Diff. in *r*'s | With *IQ* changes[2] |
|---|---|---|---|---|---|---|
| Days res. | Control | 44 | —.23 | —.66** | —.43** | —.40** |
| Days res. | Control 30 mos.[1] | 31 | —.41* | —.55** | —.14 | —.05 |
| Days res. | Preschool | 46 | —.27 | —.13 | .14 | .20 |
| Days res. | Preschool 30 mos.[1] | 29 | —.38* | —.14 | .24* | .44** |
| School attend. | Preschool | 46 | —.29* | —.07 | .22* | .27* |
| School attend. | Preschool 30 mos.[1] | 29 | —.40* | —.15 | .25* | .46** |
| School attend. | Preschool | 46 | —.14 | .19 | .33* | .30* |
| School attend. | Preschool 30 mos.[1] | 29 | —.12 | —.01 | .11 | .20 |

*Significant at the .05 level.
**Significant at the .01 level.

[1]Excluding those with initial tests given at less than 30 months of age.
[2]In calculating the preschool *r*'s of .20, .27, and .30 we used for case No. 37 the final *IQ* of 90 as of the data supplied us in 1939. The penultimate value of 77 used in their re-analysis was, although on the record, definitely not used in the original analysis of all possible changes.

In Table 1 will be found a comparison of their method of inferring that changes in *IQ* are related to a given variable by noting the change in *r*'s, versus the direct correlating of changes in *IQ* with the given variables.

These direct correlations with changes tend in most instances to augment their conclusions. Thus the plausible hypothesis that amount and regularity of preschool attendance, for children previously living in an environment of intellectual stagnation, leads to gains in *IQ*'s is borne out by correlations which run as high as .46; and the *r* of —.40 between length of residence and *IQ* changes for the control group is a more forceful way of stating that loss or deterioration was associated with residence. From the sampling viewpoint the true correlation between changes and school attendance could be higher or lower than .46. Taken on its face value, it indicates definitely that *IQ* gains can be produced, but whether such gains are due to preschool learning or to increased rapport as a result of the preschool experience cannot be determined by statistical analysis or by argumentation or by fiat. The

method of directly correlating changes with days of residence for the control group shows that when the 13 children with initial tests at or under 30 months of age are removed, the correlation drops from —.40 to —.05, a fact which is definitely contrary to their conclusion "that the presence of children younger than 30 months in the total group was not the crucial factor—" (4, p. 259; 263). The inclusion of the younger children would appear to be quite crucial for conclusions (*a*) and (*b*) quoted at the beginning of this note.

There is, however, another and more convincing reason why we must again deny the validity of conclusions (*a*) and (*b*). When one examines the scattergram for changes versus days of residence, it is at once noted that the correlation of —.40 is due to the eight children with 839 or more days of residence. One cannot, of course, legitimately ignore these extremes, but it is of interest to note that for the 36 children with residence up to 686 days the loss in *IQ* with residence is represented by the trivial *r* of —.04. It is apparent that there was no tendency for losses prior to 800 days of residence, whereas those eight cases with longest residence lost an average of 14.9 *IQ* points. This would seem to mean that there was a critical point in terms of residence beyond which large deteriorations took place *if* it were not for the fact that these eight cases lost an average of 15.1 points during the first 600 (average of 562) days of residence. No significance can, of course, be attached to their gain of .2 points during the last full year of residence, but the failure to lose more is diametrically opposed to the conclusion that "the general tendency of the control group was for longer residence to be associated with increasingly low *IQ*'s" (4, p, 263). Incidentally, the exclusion of the two cases with largest losses reduces the correlation to —.13. This would indicate the need for caution when an *r* is based on a small sample.

We are thus confronted with the situation of 36 control children showing no tendency to lose during 686 or less days of residence, while during less than 600 days eight other control children show a mean loss of 15.1 *IQ* points which loss persists during their continued residence so that there results a correlation of —.40 when all 44 cases are considered. To say that this correlation is due to what happens in eight cases (actually six cases since two of the eight did not lose) is not an explanation of the correlation, but before we accept the conclusion that this *r* indicates that long residence leads to deterioration, we must raise another question.

The question we are about to ask is so obvious that we overlooked it in our earlier critique (1) for the obvious reason that one doesn't raise obvious questions about factors which should obviously be controlled in scientific

investigations. Could this correlation of —.40 have occurred as a result of selection? It will be recalled that some children left the groups "for adoption or kindergarten" (4, p. 240). In fact, 28 of the 44 controls were dropped out before the termination of the project. When one spots these "selected out" cases on the scattergram for changes versus residence, it is immediately apparent that 11 of 12 who gained from 8 to 27 points were selected out for adoption or kindergarten or other reasons, which means that those making the large gains during the first 600 days of the project had no chance to be included as long-time residents. Furthermore, those three cases showing the largest losses from initial to final of 43, 37, and 23 points, lost during the first 600 days 40, 37, and 20 points respectively. Since these losses brought their *IQ*'s down to 63, 61, and 63, they would not be selected out for adoption or kindergarten, hence they remain in the group until the end of the project.

Dropping out of the preschool group seems not to be associated inversely with losses, but 7 of the 12 gaining 8 or more points were selected out. Since the four showing the largest gains (14 to 25 points) were taken out, it seems safe to infer that the correlations of changes with school attendance would have been somewhat higher had no selective factors been operative.

These selective factors for the control group constitute an incontrovertible explanation, firstly, for differences, tested by analysis of variance, between control and preschool groups of long residence, and secondly, for the correlation of —.40 between changes and days of residence for the controls. Conclusions (*a*) and (*b*) are therefore not tenable. Moreover, the hypothesis that continued residence in the control environment would produce losses is scarcely a plausible hypothesis when one considers a necessary corollary: prior to inclusion in the control group the individuals must have had some intellectual stimulation in order to have had initial *IQ*'s high enough to permit losses. We have been told, however, that "it goes without saying that prior to their residence in the institution, the home situation of the children afforded few opportunities for development in any sense of the word. A few children admitted as infants have experienced essentially only the environment of the orphanage" (3, p. 8). Let us consider the eight children of longest residence. Since two of them did not lose, the other six with an average loss of 21.2 from initial to final (21.7 during the first 600 days) actually account for the "deterioration" with prolonged residence. These six entered the orphanage at an average age of four months, and by an average of 16 months later their mean (initial) *IQ* was 89. How they could reach this lofty peak in an environment so lacking in intellectual

stimulation that the next 20 months would lead to an average loss of 21.7 is indeed nonplussing.

Some readers will have noted that certain of our calculations would not be possible from the published data. These have been made from data supplied us in 1939.

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*Department of Psychology*
*Stanford University*
*Stanford University, California*

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# CRITICAL REVIEWS OF RECENT BOOKS

*The Journal of Genetic Psychology*, 1945, **67**, 223-226.

*(Hollingworth, L. S. Children Above 180 IQ. New York: World Book, 1942. Pp. 332.)*

Reviewed by George G. Thompson

In the preface to this posthumous publication on children testing above 180 *IQ* Leta S. Hollingworth stated that her interest in children of extremely high intelligence was first aroused in 1912, when she read Galton's *Hereditary Genius* as an assigned reading in one of Professor Thorndike's courses. This early interest was further stimulated with the publication, in 1916, of Professor Terman's *Stanford Revision of the Binet-Simon Scale for Measuring Intelligence*. It was through a class demonstration of the administration of this intelligence scale that Professor Hollingworth saw for the first time a child (called *E* in this book) who tested above 180 *IQ*. From this early discovery until the time of her death in 1939 she was continuously alert for other children of this high level of intelligence. She felt that it was futile to make a systematic search for children testing above 180 *IQ* (S-B) because there was such a small number of them, even in a population as large as metropolitan New York City. In a period of slightly more than 20 years she found 12 children who tested above 180 *IQ* (S-B). From her reports it is known that Professor Hollingworth carefully followed the development of these children—in many cases giving them personal and vocational guidance. It cannot be assumed that all children testing above 180 *IQ* will make such satisfactory adjustments in life as the youth reported in this book, because few of these children will have available such competent counsel.

Only parts of the present report were completed by Leta S. Hollingworth during her lifetime. The final report which makes up this book was prepared for publication by Professor Harry L. Hollingworth. It is unfortunate that Leta S. Hollingworth was not able to complete the reports on the later life of these children. The present book is an extremely valuable contribution to psychological knowedge but is often repetitious from section to section. Undoubtedly, had she been able, Leta S. Hollingworth would have revised the materials on genius in the first section and the materials on educational policies in the last section. However, this volume stands as a noteworthy monument in a field which has been given too little consideration in research and in educational philosophy. Pro-

fessor Hollingworth's work opens the door to further research into the related concepts of genius, creativity, and high intelligence.

The first section of this volume is devoted to a review of previously published discussions about genius, eminent adults, and children of extremely high intelligence. In discussing the historical concepts of genius the author refers to the definitions of such men as Ovid, Lombroso, Kretschmer, Galton and others. She points out how Galton for the first time in human thought applied the concepts of probability to genius. Quotations from various scientists and philosophers are presented in which the concept of genius has been associated with such personal characteristics as loneliness, insanity, originality, specialized aptitudes, and general nervous instability.

In the second chapter the author stated that since her study was limited to data on children, no attempt would be made to review in detail the many studies of eminent adults. However, a short summary of Yoder's study, published in 1898, is presented. A rather complete bibliography of studies in this area is presented at the end of this six-page chapter.

In the third chapter Professor Hollingworth included many of the reports of children who were considered by various writers to be of exceptionally high intelligence. These reports fall into three general classifications: children observed before Binet's scale of intelligence was developed, children who tested above 180 *IQ* on the Binet-Simon scales, and children who tested above 180 *IQ* on the Stanford-Binet scale. Short developmental histories of these various children are presented. One wonders why the author did not translate the German summaries into English for the benefit of teachers who may not have this foreign-language skill. Some generalizations that can be derived from these various studies are presented. They include the following: (*a*) origin as regards racial stock is varied, (*b*) socio-economic status of the children's parents is moderate, (*c*) age of parents at birth covers a wide range, (*d*) ages of walking, talking in sentences and reading are decidedly lower than for the average child, (*e*) general health is good and physique usually superior, and (*f*) there is approximately an equal number of boys and girls (if one includes the 12 cases of the author).

In Part II of this book (including chapters four to seventeen) are presented developmental histories of 12 children who tested above 180 *IQ* (S-B). These developmental histories include materials on family background, preschool and later school histories, mental and physical measurements, and traits of character. Some of these developmental reports provide fascinating anecdotes of the behavior of these exceptional children. Samples of creative work in linguistics, mathematics, art, and literature are presented for certain children.

One of the most interesting examples of creativity among these children is the case of Subject *D* (male) who from year four to seven became interested in an imaginary land which he called "Borningtown." According to this report he spent many hours peopling Borningtown, drawing maps of its roads and terrain, recording its language ("Bornish"), and writing its literature and history. During these years he constructed a lengthy dictionary of the Bornish language.

Other interesting examples of creativity among these children are presented in the form of original poetry. One of the short poems of Child *H* (female) written at age eight years, six months is presented below.

> On the clover fields he roams,
> In the mountains,
> At the homes,
> Makes the trees and flowers grow,
> And manufactures pure, white snow. (p. 191.)

A collection of the "best" poems written by *H* between 5.5 to 8.5 years of age covers 17 typewritten pages.

Professor Hollingworth reported that about one-third of these children showed notable signs of creativeness, another third showed creative ability to a moderate degree, and the remaining third showed no indication of marked constructive originality. ". . . the problem of the correlation of originality with intelligence scores perhaps deserves more careful study than it has received" (p. 240-241). This statement by the author is especially important since the term genius is very frequently associated by the layman, and professional worker as well, with creativity.

In summarizing the early behavior records of these extremely intelligent children, Professor Hollingworth stated that age of talking and reading are the two developmental aspects of early behavior that most clearly differentiate these children from the norms.

> These activities, both involving the use and understanding of symbols, are the earliest clear expressions of mental liveliness. After they have appeared, the gifted child's characteristics appear in those traits called understanding, judgment, learning, discrimination, and in the interest in and capacity for such linguistic and abstract activities as are provided by school work. It is, therefore, in the earlier scholastic activities and in social relations that these children most notably declare their quality under our prevailing system of child management (p. 228).

Data are presented to show that children who test at and above 180 *IQ* constitute the "top" among college graduates. They are the students most likely to win prizes and honors for intellectual work. Data from Hollingworth and Rust (1937) are also presented to demonstrate that adolescents

who as children tested from 135-190 *IQ* (S-B) are less neurotic, more self-sufficient, and less submissive than the adults represented in the Bernreuter norms.

The interesting concept of "optimum intelligence" for our culture is discussed. The author concluded from a consideration of vocational and general social adjustment that children with *IQ*'s between 130 to 150 seem to find the world well suited to their development and happiness. They are sufficiently intelligent to stand out from the crowd and they usually win the confidence and friendship of their contemporaries. Children with *IQ*'s near 180 frequently are misunderstood by their peers and have difficulty in making satisfactory social and intellectual adjustments in school and community life unless some special provisions are made for their education. These problems of adjustment are especially difficult for the child of 180 *IQ* when he is between four to nine years of age. "To have the intelligence of an adult and the emotions of a child combined in a childish body is to encounter certain difficulties" (p. 282). As the exceptionally intelligent child matures physically and is given more freedom to plan his own activities he typically finds it easier to make satisfactory social and educational adjustments.

The last two chapters of this book are devoted to a consideration of the educational opportunities that can, and the author feels "should," be provided for children with *IQ*'s at or above 180. Much of this material has previously appeared in other scientific publications. One feels that this portion of the book is the most incomplete and is the part that Professor Hollingworth would have most wanted other research workers to continue to explore. Although the author reviewed the splendid work she supervised and guided in setting up special classes and curricula for the exceptionally brilliant child in New York City, she recognized that the special class is feasible only in large metropolitan areas. She discussed briefly the possibilities of curriculum enrichment and promotion policies, but one gets the impression that she was merely presenting hypotheses which she would have later wanted to test experimentally.

The contributions of this book to our knowledge of extremely intelligent children are highly important. It is to be hoped that since this publication is so "readable" it will have a large and varied audience. Perhaps other scientists will be stimulated to continue the work to which Leta S. Hollingworth devoted more than 20 years of her lifetime.

*School of Education*
*Syracuse University*
*Syracuse, New York*

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